

LIBRARY OF CONGRESS.

Chap. SF523 Copyright No.

Shelf .C765

UNITED STATES OF AMERICA.

MANUAL

OF

THE APIARY,

BY

A. J. COOK,

Professor of Entomology

IN THE

MICHIGAN STATE AGRICULTURAL COLLEGE,

12
Y682a

THIRD EDITION,

REVISED, ENLARGED, MOSTLY RE-WRITTEN AND BEAUTIFULLY ILLUSTRATED.

No. 5164 D

CHICAGO, ILLS.:
THOMAS G. NEWMAN & SON,
1878.

SF523
.C765

Entered according to Act of Congress, in the year 1878, by
THOMAS G. NEWMAN & SON,
In the Office of the Librarian of Congress, at Washington, D. C.

TO THE

REVEREND L. L. LANGSTROTH,

THE

INVENTOR OF THE MOVABLE FRAME HIVE,

THE

HUBER OF AMERICA, AND THE GREATEST MASTER OF PURE AND APPLIED SCIENCE, AS RELATING TO APICULTURE, IN THE WORLD; THIS MANUAL IS GRATEFULLY DEDICATED

BY

THE AUTHOR.

PREFACE TO FIRST EDITION.

THE APIARY.

Why another treatise on this subject? Have we not Langstroth, and Quinby, and King, and Bevan, and Hunter? Yes; all of these. Each of which has done excellent service in promoting an important industry. Each of which possesses peculiar and striking excellences. Yet none of these combine all of the qualities desirable in a popular manual. Hence, the excuse for another claimant for public favor. Every cultured apiarist laments that there is no text-book which possesses all of the following very desirable characters: Simple style, full in its discussions, cheap, disinterested, up with the times. It is for the bee-keeping public to decide whether this treatise meets any more fully the demands made by the latest discoveries and improvements, by the wants of those eager to learn, and by the superior intelligence which is now enlisted in the interests of the Apiary.

The following is, in substance, the same as the course of lectures which I have given each year to the students of the Michigan Agricultural College, and their desire, as expressed in repeated requests, has led to this publication.

It will be my desire to consider subjects of merely scientific interest and value, as fully as scientific students can reasonably desire; and, that such discussions may not confuse or perplex those who only read or study with practical ends in view, a very full index is added, so that the whereabouts of any topic, either of practical or scientific value, can be easily ascertained.

In considering the various subjects of interest to the bee-keeper, I am greatly indebted to the authors mentioned above, and also to the following journals, all worthy of high commendation: Gleanings in Bee Culture, American Bee Journal, Bee-Keepers' Magazine, and Bee World.

The illustrations for this manual were nearly all drawn by the author from the natural object.

MICHIGAN AGRICULTURAL COLLEGE,
LANSING, May 1, 1876.

PREFACE TO SECOND EDITION.

I little thought when I sent out, less than two years ago, the first edition—3,000 copies—of my little, unpretending, "Manual of the Apiary," that more than 2,000 copies would be sold in less than one year, and that in less than two years a second edition would be demanded by the apiarists of our country.

The very kindly reviews and flattering notices by apiarian, scientific, and other journals, both American and foreign, and the approval, as expressed by numerous friendly letters, of our most eminent apiarists, as also the "unprecedented sale of this little work," have not only been very gratifying, but also assure me that I was quite right in the opinion that the time was ripe for some such treatise.

At the urgent request of many apiarian friends, in response to the oft-repeated desire of my many students, some of whom are becoming leading apiculturists in our country, and at the suggestion of many noted apiarists with whom I have no personal acquaintance, I now send forth this second edition, greatly enlarged, mostly re-written, even more fully illustrated, and containing the latest scientific discoveries, and most recent improvements in methods of apiarian management and bee-keeping apparatus.

It is impossible for me to state how greatly I am indebted to our excellent American bee periodicals, and enterprising and intelligent apiarists, for many—yea, for most—of the valuable thoughts and suggestions which may be found in the following pages. I am tempted to mention names of those whose aid and favors have been especially useful, but find the list so large that I must, perforce, forego the privilege, and only refer to such persons in the text.

With the hope that this second edition may reach even more who desire instruction in this pleasing art, and that it may still further advance the interests of scientific apiculture, I send it forth to all those who wish to study more deeply into the mysteries of insect life, or to gain further knowledge of one of the most fascinating as well as profitable of arts.

I make no apology for inserting so much of science in the following pages. From the letters of inquiry which I am constantly receiving, especially from apiarists, I am convinced that the people are mentally hungry for just such

food. To satisfy and stimulate just such appetites is, I am sure, very desirable.

I recommend nothing in this treatise that I have not proved valuable by actual trial, unless I mention some eminent person as advising it; nor do I announce any fact or scientific truth that I have not verified, except as I give it on the authority of some competent person.

For most of the figures of the second edition I am indebted to one of my pupils, Mr. W. L. Holdsworth, whose skill as an artist needs no praise.

Appended to this volume is a very full index which will be a great aid to the student

CONTENTS.

INTRODUCTION.

Who May Keep Bees 11
Specialists 11
Amateurs 11
Who are Specially Interdicted 12
Inducements to Bee-Keeping 12
Recreation 12
Profit 13
Excellence as an Amateur Pursuit 15
Adaptation to Women 15
Improves the Mind and Observation 17
Yields Delicious Food 17
What Successful Bee-Keeping Requires 18
Mental Effort 18
Experience Necessary 18
Learn from Others 18
Aid from Conventions 19
Aid from Bee Papers 19
American Bee Journal 19
Gleanings in Bee Culture 20
Bee-Keepers' Magazine 21
Books for the Apiarist 21
Langstroth on the Honey-Bee 21
Quinby's Mysteries of Bee-Keeping 22
King's Text-Book 22
A, B, C of Bee Culture 22
Foreign Works 22
Promptitude 53
Enthusiasm 24

PART I.

Natural History of the Honey Bee.

CHAPTER I.

The Bee's Place in the Animal Kingdom 27
The Branch of the Honey-Bee 27
The Class of the Honey-Bee 28
The Order of the Honey-Bee 30
The Sub-Order of the Honey-Bee 31

The Family of the Honey-Bee..... 34
The Genus of the Honey-Bee..... 38
The Species of the Honey-Bee..... 41
The Varieties of the Honey-Bee..... 41
German, or Black Bee..... 47
Italian, or Ligurian..... 41
Fasciata, or Egyptian..... 43
Other Varieties..... 43
Bibliography..... 44
Valuable Books on Entomology..... 47

CHAPTER II.

Anatomy and Physiology..... 48
Anatomy of Insects..... 48
Organs of the Head..... 48
Appendages of the Thorax..... 55
Internal Anatomy..... 56
Secretory Organs..... 61
Sex Organs..... 62
Transformations..... 66
The Egg..... 67
The Larva..... 68
The Pupa..... 68
The Imago Stage..... 70
Incomplete Transformations..... 70
Anatomy and Physiology of the Honey Bee..... 71
Three Kinds of Bees in Each Colony..... 71
The Queen..... 71
The Drone..... 86
The Neuters or Workers..... 90

CHAPTER III.

Swarming, or Natural Method of Increase.....101

CHAPTER IV.

Products of Bees, their Origin and Function.....104
Honey.....104
Wax.....106
Pollen, or Bee-Bread.....111
Propolis.....112
Bibliography.....113

PART II.

The Apiary, its Care and Management.....115

INTRODUCTION.

Preparation.....117
Read a Good Manual.....117
Visit some Apiarist.....117

Take a College Course....118
Decide on a Plan....118
How to Procure our Bees....118
Kind of Bees to Purchase....119
In What Kind of Hives....119
When to Purchase....119
How Much to Pay....120
Where to Locate....120

CHAPTER V.

Hives and Boxes....122
Box Hives....122
Movable Comb Hives....123
The Langstroth Hive....123
Character of the Hive....124
The Bottom Board....127
The Cover....129
The Frames....132
How to Construct the Frames....133
A Block for making Frames....134
Cover for Frames....136
Division Board....137
The Huber Hive....138
Apparatus for Securing Comb Honey....141
Boxes....142
Small Frames or Sections....144
Requisites of Good Frames....144
Description....144
How to Place Sections in Position....147
Sections in Frames....147
Sections in Racks....149

CHAPTER VI.

Position and Arrangement of the Apiary....152
Position....152
Arrangement of Ground....152
Preparation for each Colony....153

CHAPTER VII.

To Transfer Bees....156

CHAPTER VIII.

Feeding and Feeders....159
How Much to Feed....159
How to Feed....160

CHAPTER IX.

Queen Rearing....163
How to Rear Queens....163
Nuclei....165
Shall we Clip the Queen's Wing?....168

CHAPTER X.

Increase of Colonies....171
Swarming....171
Hiving Swarms....173
To Prevent Second Swarms....175
To Prevent Swarming....176
How Best to Increase....177
Dividing....177
How to Divide....177

CHAPTER XI.

Italians and Italianizing....180
All Should Keep only Italians....183
How to Italianize....183
How to Introduce a Queen....183
To Get Italian Queens....185
Rearing and Shipping Queens....186
To Ship Queens....186
To Move Colonies....187

CHAPTER XII.

Extracting and the Extractors....188
Honey Extractor....188
What Style to Buy....189
Use of the Extractor....191
When to use the Extractor....192
How to Extract....194

CHAPTER XIII.

Handling Bees....195
The Best Bee Veil....196
To Quiet Bees....197
Bellows Smoker....198
The Quinby Smoker....198
The Bingham Smoker....199
How to Smoke Bees....201
To Cure Stings....201
The Sweat Theory....201

CHAPTER XIV.

Comb Foundation....203
History....203
American Foundation....204
How Foundation is Made....206
To Secure the Wax Sheets....206
Use of Foundation....207
To Fasten the Foundation....209
Save the Wax....211
Methods....211

CHAPTER XV.

Marketing Honey....213
How to Invigorate the Market....213
Extracted Honey....214
How to Tempt the Consumer....214
Comb Honey....215
Rules to be Observed....215

CHAPTER XVI.

Honey Plants....218
What are the Valuable Honey Plants?....220
Description with Practical Remarks....222
April Plants....223
May Plants....225
June Plants....228
July Plants....237
August and September Plants....242
Books on Botany....244
Practical Conclusions....244

CHAPTER XVII.

Wintering Bees....246
The Cause of Disastrous Wintering....246
Requisite to Safe Wintering—Good Food....248
Secure Late Breeding....249
To Secure and Maintain Proper Temperature....249
Box for Packing....250
Chaff Hives....251
Wintering in Cellar or House....252
Burying Bees....254
Spring Dwindling....254

CHAPTER XVIII.

The House Apiary....255
Description....255
Are they Desirable....256
The Case as it Now Stands....256

CHAPTER XIX.

Evils that Confront the Apiarist....258
Robbing....258
Disease....259
Foul Brood....259
Remedies....260
Enemies of Bees....262
The Bee Moth....262
History....266
Remedies....266
Bee Killer....267

Bee Louse....268
Important Suggestion....269
Bee Hawk....269
Tachina Fly....270
Spiders....271
Ants....271
Wasps....271
The King Bird....272
Toads....272
Mice....272

CHAPTER XX.

Calendar and Axioms....274
Work for Different Months....274
January....274
February....274
March....274
April....275
May....275
June....275
July....275
August....275
September....276
October....276
November....276
December....276
Axioms....277

ILLUSTRATIONS.

1. Trachea.... 28
2. Respiratory Apparatus of a Bee.... 29
3. Bee's Wings.... 38
4. Head of Drone.... 39
5. Head of Worker.... 39
6. Head of Bee.... 49
7. Thorax of Bee.... 55
8. Nervous System of Drone.... 58
9. Alimentary Canal.... 60
10. Male Organs of Bee.... 63
11. Queen Organs.... 64
12. Larva of Bee.... 68
13. Pupa of Bee.... 69
14 Queen Bee.... 72
15. Labium of Queen.... 73
16. Part of Queen's Leg.... 74

17. Drone..... 86
18. Part of Drone's Leg..... 87
19. Worker Bee..... 90
20. Tongue of Worker Bee..... 91
21. Jaw of Queen, Drone and Worker..... 92
22. Part of Posterior Leg of Worker—outside..... 93
23. Part of Posterior Leg of Worker—inside..... 94
24. Anterior Leg of Worker..... 94
25. Sting of Worker..... 95
26. Egg and Brood..... 97
27. Wax Scales.....106
28. Honey-Comb.....109
29. Langstroth Hive.....124
30. Body of Hive.....125
31. Bevel Gauge.....126
32. Bottom-Board.....128
33. Two-Story Hive.....130
34. Cover to Hive.....131
35. Frame.....133
36. Frame, with Cross-Section of Top-Bar.....134
37. Block for making Frames.....135
38. Division-Board.....137
39. Part of Quinby Hive.....139
40. Part of Bingham Hive.....140
41. Glass Honey Box.....142
42. Isham Honey Box.....143
43. Harbison Section Frame.....143
44. Chisel.....144
45. Block for Section Making.....145
46. Hetherington Separator.....146
47. Dove-tailed Section.....146
48. Phelps Section.....147
49. Section Frame.....148
50. Sections in Frame.....149
51. Southard's Section Rack.....150
52. Wheeler's Section Rack.....150
53. Hive in Shade of Evergreen.....155
54. Feeder.....160
55. Simplicity Feeder.....161
56. Queen-cell Inserted in Comb.....167
57. Shipping Queen Cage.....187
58. Everett's Extractor.....189
59. Comb Basket for Extractor.....190
60. Knife for Uncapping.....191
61. Knife with Curved Point.....191
62. Bee-Veil.....196
63. Quinby Smokers.....199
64. Bingham Smoker.....199
65. Comb Foundation.....203
66. Comb Foundation Machine.....205

67. Comb Foundation Cutter....206
68. Block for Fastening Foundation....210
69. Presser for Block....211
70. Wax Extractor....212
71. Prize Crate....216
72. Heddon Crate....217
73. Maple....222
74. Willow....223
75. Judas Tree....224
76. American Wistaria....225
77. Chinese Wistaria....226
78. Barberry....226
79. White Sage....227
80. White or Dutch Clover....228
81. Alsike Clover....229
82. Melilot Clover....230
83. Borage....230
84. Mignonette....231
85. Okra....231
86. Mint....232
87. Pollen of Milk-Weed....233
88. Black Mustard....233
89. Rape....234
90. Tulip....235
91. Teasel....236
92. Cotton....236
93. Basswood....237
94. Figwort....238
95. Button-Bush....240
96. Rocky Mountain Bee Plant....239
97. Boneset....241
98. Buckwheat....242
99. Golden Rod....243
100. Sun Flower....243
101. Packing-Box for Winter....250
102. Gallery of Moth Larva....262
103. Moth Larva in Comb....263
104. Moth Larvæ....264
105. Moth Cocoons....264
106. Moth with Wings Spread....264
107. Male and Female Moths....265
108. Bee-Killer....268
109. Bee Louse....268
110. Tachina Fly....270

INTRODUCTION.

WHO MAY KEEP BEES.

SPECIALISTS.

Any person who is cautious, observing, and prompt to do whatever the needs of his business requires, with no thought of delay, may make apiculture a specialty, with almost certain prospects of success. He must also be willing to work with Spartan energy during the busy season, and must persist, though sore discouragement, and even dire misfortune, essay to thwart his plans and rob him of his coveted gains. As in all other vocations, such are the men who succeed in apiculture. I make no mention of capital to begin with, or territory on which to locate; for men of true metal—men whose energy of mind and body bespeak success in advance—will solve these questions long before their experience and knowledge warrant their assuming the charge of large apiaries.

AMATEURS.

Apiculture, as an avocation, may be safely recommended to those of any business or profession, who possess the above named qualities, and control a little space for their bees, a few rods from street and neighbor, or a flat roof whereupon hives may securely rest (C. F. Muth, of Cincinnati, keeps his bees very successfully on the top of his store, in the very heart of a large city), and who are able to devote a little time, when required, to care for their bees. The amount of time will of course vary with the number of colonies kept, but with proper management this time may be granted at any time of the day or week, and thus not interfere with the regular business. Thus residents of country, village, or city, male or female, who may wish to be associated with and study natural objects, and add to their income and pleasure, will find here an ever-waiting opportunity. To the ladies, shut out from fresh air and sunshine, till pallor and languor point sadly to

departing health and vigor, and to men the nature of whose business precludes air and exercise, apiculture cannot be too highly recommended as an avocation.

WHO ARE SPECIALLY INTERDICTED.

There are a few people, whose systems seem to be specially susceptible to the poison intruded with the bee's sting. Sometimes such persons, if even stung on the foot, will be so thoroughly poisoned that their eyes will swell so they cannot see, and will suffer with fever for days, and, very rarely, individuals are so sensitive to this poison that a bee-sting proves fatal. I hardly need say, that such people should never keep bees. Many persons, among whom were the noted Klein and Gunther, are at first very susceptible to the poison, but spurred on by their enthusiasm, they persist, and soon become so innoculated that they experience no serious injury from the stings. It is a well-recognized fact, that each successive sting is less powerful to work harm. Every bee-keeper is almost sure to receive an occasional sting, though with the experienced these are very rare, and the occasion neither of fear nor anxiety.

INDUCEMENTS TO BEE-KEEPING.

RECREATION.

Among the attractive features of apiculture, I mention the pleasure which it offers its votaries. There is a fascination about the apiary which is indescribable. Nature is always presenting the most pleasurable surprises to those on the alert to receive them. And among the insect hosts, especially bees, the instincts and habits are so inexplicable and marvelous, that the student of this department of nature never ceases to meet with exhibitions that move him, no less with wonder than with admiration. Thus, bee-keeping affords most wholesome recreation, especially to any who love to look in upon the book of nature, and study the marvelous pages she is ever waiting to present. To such, the very fascination of their pursuit is of itself a rich reward for the time and labor expended. I doubt if there is any other class of manual

laborers who engage in their business, and dwell upon it, with the same fondness as do bee-keepers. Indeed, to meet a scientific bee-keeper is to meet an enthusiast. A thorough study of the wonderful economy of the hive must, from its very nature, go hand-in-hand with delight and admiration. I once asked an extensive apiarist, who was also a farmer, why he kept bees. The answer was characteristic: "Even if I could not make a good deal the most money with my bees, I should still keep them for the real pleasure they bring me." But yesterday I asked the same question of Prof. Daniels, President of the Grand Rapids schools, whose official duties are very severe. Said he: "For the restful pleasure which I receive in their management." I am very sure, that were there no other inducement than that of pleasure, I should be slow to part with these models of industry, whose marvelous instincts and wondrous life-habits are ever ministering to my delight and astonishment.

A year ago, I received a visit from my old friend and College classmate, O. Clute, of Keokuk, Iowa. Of course I took him to see our apiary, and as we looked at the bees and their handiwork, just as the nectar from golden-rod and asters was flooding the honey-cells. He became enraptured, took my little "Manual of the Apiary" home with him, and at once subscribed for the old *American Bee Journal.* He very soon purchased several colonies of bees, and has found so much of pleasure and recreation in the duties imposed by his new charge, that he has written me several times, expressing gratitude that I had led him into such a work of love and pleasure.

PROFITS.

The profits, too, of apiculture, urge its adoption as a pursuit. When we consider the comparatively small amount of capital invested, the relatively small amount of labor and expense attending its opperations, we are surprised at the abundant reward that is sure to wait upon its intelligent practice. I do not wish to be understood here as claiming that labor—yes, real hard, back-aching labor—is not required in the apiary. The specialist, with his hundred or more colonies, will have, at certain seasons, right hard and vigorous

work. Yet this will be both pleasant and healthful, and will go hand-in-hand with thought, so that brain and muscle will work together. Yet this time of hard, physical labor will only continue for five or six months, and for the balance of the year the apiarist has or may have comparative leisure. Nor do I think that all will succeed. The fickle, careless, indolent, heedless man, will as surely fail in apiculture, as in any other calling. But I repeat, in the light of many years of experience, where accurate weight, measure, and counting of change has given no heed to conjecture, that there is no manual labor pursuit, where the returns are so large, when compared with the labor and expense.

An intelligent apiarist may invest in bees any spring in Michigan, with the absolute certainty of more than doubling his investment the first season. While a net gain of 400 per cent. brings no surprise to the experienced apiarists of our State. This of course applies only to a limited number of colonies. Nor is Michigan superior to other States as a location for the apiarist. During the past season, the poorest I ever knew, our fifteen colonies of bees in the College apiary, have netted us over $200. In 1876, each colony gave a net return of $24.04, while in 1875, our bees gave a profit, above all expense, of over 400 per cent. of their entire value in the spring. Mr. Fisk Bangs, who graduated at our College one year since, purchased last spring seven colonies of bees. The proceeds of these seven colonies have more than paid all expenses, including first cost of bees, in honey sold, while there are now sixteen colonies, as clear gain, if we do not count the labor, and we hardly need do so, as it has in no wise interfered with the regular duties of the owner. Several farmers of our State who possess good apiaries and good improved farms, have told me that their apiaries were more profitable than all the remainder of their farms. Who will doubt the profits of apiculture in the face of friend Doolittle's experience? He has realized $6,000, in five years, simply from the honey taken from fifty colonies. This $6,000 is in excess of all expenses except his own time. Add to this the increase of stocks, and then remember that one man can easily care for 100 colonies, and we have a graphic picture of apiarian profits. Bee-keeping made Adam Grimm a wealthy man. It brought to

Capt. Hetherington over $10,000 as the cash receipts of a single year's honey-crop. It enabled Mr. Harbison, so it is reported, to ship from his own apiary, eleven car-loads of comb-honey as the product of a single season. What greater recommendation has any pursuit? Opportunity for money-making, even with hardships and privations, is attractive and seldom disregarded; such opportunity with labor that brings, *in itself*, constant delight, is surely *worthy* of attention.

EXCELLENCE AS AN AMATEUR PURSUIT.

Again, there is no business, and I speak from experience, that serves so well as an avocation. It offers additional funds to the poorly paid, out-door air to the clerk and office-hand, healthful exercise to the person of sedentary habits, and superb recreation to the student or professional man, and especially to him whose life-work is of that dull, hum-drum, routine order that seems to rob life of all zest. The labor, too, required in keeping bees, can, with a little thought and management, be so planned, if but few colonies are kept, as not to infringe upon the time demanded by the regular occupation. Indeed, I have never been more heartily thanked, than by such persons as named above, and that, too, because I called them to consider—which usually means to adopt—the pleasing duties of the apiary.

ADAPTATION TO WOMEN.

Apiculture may also bring succor to those whom society has not been over-ready to favor—our women. Widowed mothers, dependent girls, the weak and the feeble, *all* may find a blessing in the easy, pleasant, and profitable labors of the apiary. Of course, women who lack vigor and health, can care but for very few colonies, and must have sufficient strength to bend over and lift the small-sized frames of comb when loaded with honey, and to carry empty hives. With the proper thought and management, full colonies need never be lifted, nor work done in the hot sunshine. Yet right here let me add, and emphasize the truth, *that only those who will let energetic thought and skillful plan, and above all promptitude and persistence, make up for physical weak-*

ness, should enlist as apiarists. Usually a stronger body, and improved health, the results of pure air, sunshine, and exercise, will make each successive day's labor more easy, and will permit a corresponding growth in the size of the apiary for each successive season. One of the most noted apiarists, not only in America but in the world, sought in bee-keeping her lost health, and found not only health, but reputation and influence. Some of the most successful apiarists in our country are women. Of these, many were led to adopt the pursuit because of waning health, grasping at this as the last and successful weapon with which to vanquish the grim monster. Said "Cyula Linswik"—whose excellent and beautifully written articles have so often charmed the readers of the bee publications, and who has had five years of successful experience as an apiarist—in a paper read before our Michigan Convention of March, 1877: "I would gladly purchase exemption from in-door work, on washing-day, by two days' labor among the bees, and I find two hours' labor at the ironing-table more fatiguing than two hours of the severest toil the apiary can exact. * * * I repeat, that apiculture offers to many women not only pleasure but profit. * * * Though the care of a few colonies means only recreation, the woman who experiments in bee-keeping somewhat extensively, will find that it means, at some seasons, genuine hard work. * * * There is risk in the business, I would not have you ignore this fact, but an experience of five years has led me to believe that the risk is less than is generally supposed." Mrs. L. B. Baker, of Lansing, Michigan, who has kept bees very successfully for four years, read an admirable paper before the same Convention, in which she said: "But I can say, having tried both," (keeping boarding-house and apiculture,) "I give bee-keeping the preference, as more profitable, healthful, independent and enjoyable. * * * I find the labors of the apiary more endurable than working over a cook-stove in-doors, and more pleasant and conducive to health. * * * I believe that many of our delicate and invalid ladies would find renewed vigor of body and mind in the labors and recreations of the apiary. * * * By beginning in the early spring, when the weather was cool and the work light, I became gradually accustomed to out-door labor, and by mid-

summer found myself as well able to endure the heat of the sun as my husband, who has been accustomed to it all his life. Previously, to attend an open-air picnic was to return with a head-ache. * * * My own experience in the apiary has been a source of interest and enjoyment far exceeding my anticipations." Although Mrs. Baker commenced with but two colonies of bees, her net profits the first season were over $100; the second year but a few cents less than $300; and the third year about $250. "The proof of the pudding is in the eating;" so, too, such words as given above, show that apiculture offers special inducements to our sisters to become either amateur or professional apiarists.

IMPROVES THE MIND AND THE OBSERVATION.

Successful apiculture demands close and accurate observation, and hard, continuous thought and study, and this, too, in the wondrous realm of nature. In all this, the apiarist receives manifold and substantial advantages. In the cultivation of the habit of observation, a person becomes constantly more able, useful and susceptible to pleasure, results which also follow as surely on the habit of thought and study. It is hardly conceivable that the wide-awake apiarist, who is so frequently busy with his wonder-working comrades of the hive, can ever be lonely, or feel time hanging heavily on his hands. The mind is occupied, and there is no chance for *ennui.* The whole tendency, too, of such thought and study, where nature is the subject, is to refine the taste, elevate the desires, and ennoble manhood. Once get our youth, with their susceptible natures, engaged in such wholesome study, and we shall have less reason to fear the vicious tendencies of the street, or the luring vices and damning influences of the saloon. Thus apiculture spreads an intellectual feast, that even the old philosophers would have coveted; furnishes the rarest food for the observing faculties, and, best of all, by keeping its votaries face to face with the matchless creations of the *All Father*, must draw them toward Him "who went about doing good," and in "whom there was no guile."

YIELDS DELICIOUS FOOD.

A last inducement to apiculture, certainly not unworthy of mention, is the offerings it brings to our tables. Health, yea,

our very lives, demand that we should eat sweets. It is a truth that our sugars, and especially our commercial syrups, are so adulterated as to be often poisonous. The apiary, in lieu of these, gives us one of the most delicious and wholesome of sweets, which has received merited praise, as food fit for the gods, from the most ancient time till the present day. To ever have within reach the beautiful, immaculate comb, or the equally grateful nectar, right from the extractor, is certainly a blessing of no mean order. We may thus supply our families and friends with a most necessary and desirable food element, and this with no cloud of fear from vile, poisonous adulterations.

WHAT SUCCESSFUL BEE-KEEPING REQUIRES.

MENTAL EFFORT.

No one should commence this business who is not willing to read, think and study. To be sure, the ignorant and unthinking may stumble on success for a time, but sooner or later, failure will set her seal upon their efforts. Those of our apiarists who have studied the hardest, observed the closest, and thought the deepest, have even passed the late terrible winters with but slight loss.

Of course the novice will ask, How and what shall I study?

EXPERIENCE NECESSARY.

Nothing will take the place of real experience. Commence with a few colonies, even one or two is best, and make the bees your companions at every possible opportunity. Note every change, whether of the bees, their development, or work, and then by earnest thought strive to divine the cause.

LEARN FROM OTHERS.

Great good will also come from visiting other apiarists. Note their methods and apiarian apparatus. Strive by conversation to gain new and valuable ideas, and gratefully adopt whatever is found, by comparison, to be an improvement upon your own past system and practice.

AID FROM CONVENTIONS.

Attend conventions whenever distance and means render this possible. Here you will not only be made better by social intercourse with those whose occupation and study make them sympathetic and congenial, but you will find a real conservatory of scientific truths, valuable hints, and improved instruments and methods. And the apt attention—rendered possible by your own experience—which you will give to essays, discussions and private conversations, will so enrich your mind, that you will return to your home encouraged, and able to do better work, and to achieve higher success. I have attended nearly all the meetings of the Michigan Convention, and never yet when I was not well paid for all trouble and expense by the many, often very valuable, suggestions which I received. These I would carry home, and test as commanded by the Apostle: "Prove all things and hold fast that which is good."

AID FROM BEE PUBLICATIONS.

Every apiarist, too, should take and read at least one of the three excellent bee publications that are issued in our country. It has been suggested that Francis Huber's blindness was an advantage to him, as he thus had the assistance of two pairs of eyes, his wife's and servant's, instead of one. So, too, of the apiarist who reads the bee publications. He has the aid of the eyes, and the brains, too, of hundreds of intelligent and observing bee-keepers. Who is it that squanders his money on worse than useless patents and fixtures? He who "*cannot afford*" to take a bee-journal.

It would be invidious and uncalled for to recommend any one of these valuable papers to the exclusion of the others. Each has its peculiar excellences, and all who can, may well secure all of them to aid and direct their ways.

AMERICAN BEE JOURNAL.

This, the oldest bee publication, is not only peculiar for its age, but for the ability with which it has been managed, with scarce any exception, even from its first appearance. Samuel Wagner, its founder and long its editor, had few superiors in breadth of culture, strength of judgment, and practical and

historic knowledge of apiculture. With what pleasure we remember the elegant, really classic, diction of the editorials, the dignified bearing, and freedom from asperities which marked the old American Bee Journal as it made its monthly visits fresh from the editorial supervision of Mr. Samuel Wagner. Some one has said that there is something in the very atmosphere of a scholarly gentleman, that impresses all who approach him. I have often thought, as memory reverted to the old American Bee Journal, or as I have re-read the numbers which bear the impress of Mr. Wagner's superior learning, that, though the man is gone, the stamp of his noble character and classical culture is still on these pages, aiding, instructing, elevating, all who are so fortunate as to possess the early volumes of this periodical. I am also happy to state that the American Bee Journal is again in good hands, and that its old prestige is fully restored. Mr. Newman is an experienced editor, a man of excellent judgment and admirable balance, a man who demonstrates his dislike of criminations and recriminations by avoiding them; who has no special inventions or pet theories to push, and is thus almost sure to be disinterested and unbiased in the advice he offers; who lends his aid and favor to our Conventions, which do so much to spread apiarian knowledge. And when I add, that he brings to his editorial aid the most able, experienced and educated apiarists of the world, I surely have spoken high but *just* praise, of the American Bee Journal, whose enviable reputation extends even to distant lands. It is edited by Thomas G. Newman, at Chicago. Price, $2.00 a year.

GLEANINGS IN BEE CULTURE.

This periodical makes up for its brief history of only five years, by the vigor and energy which has characterized it from the first. Its editor is an active apiarist, who is constantly experimenting; a terse, able writer, and brimming-full of good nature and enthusiasm. I am free to say, that in practical apiculture I am more indebted to Mr. Root than to any other one person, except Rev. L. L. Langstroth. I also think that, with few exceptions, he has done more for the recent advancement of practical apiculture than any other person in our country. Yet I have often regretted that Mr. Root is so

inimical to conventions, and that he often so stoutly praises that with which he has had so brief an experience, and must consequently know so little. This trait makes it imperative that the apiarist read discriminately, and then decide for himself. In case of an innovation, wait for Mr. Root's continued approval, else prove its value before general adoption. This sprightly little journal is edited by A. I. Root, Medina, Ohio. Price, $1.00 a year.

BEE-KEEPER'S MAGAZINE.

I have read this periodical less, and, of course know less of it than of the others. It is well edited, and certainly has many very able contributors. Both Mr. King and Mr. Root deal largely in their own wares, and, of course, give space to their advertisement, yet, in all my dealings with them, and I have dealt largely with Mr. Root, I have ever found them prompt and reliable. The Magazine is edited by A. J. King, New York. Price, $1.50 a year.

BOOKS FOR THE APIARIST.

Having read very many of the books treating of apiculture, both American and foreign, I can freely recommend such a course to others. Each book has peculiar excellences, and each one may be read with interest and profit.

LANGSTROTH ON THE HONEY BEE.

Of course, this treatise will ever remain a classic in bee-literature. I cannot over-estimate the benefits which I have received from the study of its pages. It was a high, but deserved encomium, which J. Hunter, of England, in his "Manual of Bee-Keeping," paid to this work: "It is unquestionably the best bee-book in the English language."

The style of this work is so admirable, the subject matter so replete with interest, and the entire book so entertaining, that it is a desirable addition to any library, and no thoughtful, studious apiarist can well be without it. It is especially happy in detailing the methods of experimentation, and in showing with what caution the true scientist establishes principles or deduces conclusions. The work is wonderfully free from errors, and had the science and practice of apiculture remained stationary, there would have been little need of

another work; but as some of the most important improvements in apiculture are not mentioned, the book alone would be a very unsatisfactory guide to the apiarist of to-day. Price, $2.00.

QUINBY'S MYSTERIES OF BEE-KEEPING.

This is a plain, sensible treatise, written by one of America's most successful bee-keepers. It proceeds, I think, on a wrong basis in supposing that those who read bee-books will use the old box-hives, especially as the author is constantly inferring that other hives are better. It contains many valuable truths, and when first written was a valuable auxiliary to the bee-keeper. I understand that the work is now being revised by Mr. L. C. Root. Price, $1.50.

KING'S TEXT-BOOK.

This is a compilation of the above works, and, like them, is in great need of revision (which I understand is being accomplished by able apiarists), being away behind the times. Its concise manner and judicious arrangement are worthy of praise. Price, 75 cents.

A B C OF BEE-CULTURE.

This work, now in progress, is to be issued in eight or ten numbers, the first of which has already appeared. It is arranged in the convenient form of our cyclopœdias, is printed in fine style, on beautiful paper, and is to be well illustrated. I need hardly say that the style is pleasing and vigorous. The subject matter will, of course, be fresh, embodying the most recent discoveries and inventions pertaining to bee-keeping. That it may be kept abreast of apiarian progress, the type is to be kept in position, so that each new discovery may be added as soon as made. The entire cost of this work will probably not exceed $3.00.

FOREIGN WORKS.

Bevan, revised by Munn, is exceedingly interesting, and shows by its able historical chapters, admirable scientific disquisitions, and frequent quotations and references to practical and scientific writers on bees and bee-keeping, both ancient and modern, that the writers were men of extensive reading

and great scientific ability. The book is of no practical value to us, but to the student it will be read with great interest. Next to Langstroth, I value this work most highly of any in my library that treats of bees and bee-keeping, if I may except back volumes of the bee-publications.

"The Apiary, or Bees, Bee-Hives and Bee Culture," by Alfred Neighbour, London, is a fresh, sprightly little work, and as the third edition has just appeared, is, of course, up with the times. The book is in nice dress, concise, and very readable, and I am glad to commend it.

A less interesting work, though by no means without merit, is the "Manual of Bee-Keeping," by John Hunter, London. This is also recent. I think these works would be received with little favor among American apiarists. They are exponents of English apiculture, which in method would seem clumsy to Americans. In fact, I think I may say that in implements and perhaps I may add methods, the English, French, Germans and Italians, are behind our American apiarists, and hence their text-books and journals compare illy with ours. I believe the many intelligent foreign apiarists who have come to this country and are now honored members of our own fraternity, will sustain this position. *Foreign scientists* are ahead of American, but we glean and utilize their facts and discoveries as soon as made known. Salicylic acid is discovered by a German to be a remedy for foul brood, yet ten times as many American as foreign apiarists know of this and practice by the knowledge. In practical fields, on the other hand, as also in skill and delicacy of invention, we are, I think, in advance. So our apiarists have little need to go abroad for either books or papers.

PROMPTITUDE.

Another absolute requirement of successful bee-keeping, is prompt attention to all its varied duties. Neglect is the rock on which many bee-keepers, especially farmers, find too often that they have wrecked their success. I have no doubt that more colonies die from starvation, than from all the bee maladies known to the bee-keeper. And why is this? Neglect is the apicide. I feel sure that the loss each season by absconding colonies is almost incalculable, and whom must

we blame? Neglect. The loss every summer by enforced idleness of queen and workers, just because room is denied them, is very great. Who is the guilty party? Plainly, neglect. In these and in a hundred other ways, indifference to the needs of the bees, which require but a few moments, greatly lessen the profits of apiculture. If we would be successful, promptitude must be our motto. Each colony of bees requires but very little care and attention. Our every interest demands that this be not denied, nor even granted grudgingly. The very fact that this attention is slight, renders it more liable to be neglected; but this neglect always involves loss—often disaster.

ENTHUSIASM.

Enthusiasm, or an ardent love of its duties is very desirable, if not an absolute requisite, to successful apiculture. To be sure, this is a quality whose growth, with even slight opportunity, is almost sure. It only demands perseverance. The beginner, without either experience or knowledge, may meet with discouragements—unquestionably will. Swarms will be lost, colonies will fail to winter, the young apiarist will become nervous, which fact will be noted by the bees with great disfavor, and if opportunity permits, will meet reproof more sharp than pleasant. Yet, with PERSISTENCE, all these difficulties quickly vanish. Every contingency will be foreseen and provided against, and the myriad of little workers will become as manageable and may be fondled as safely as a pet dog or cat, and the apiarist will minister to their needs with the same fearlessness and self-possession that he does to his gentlest cow or favorite horse. *Persistence in the face of all those discouragements which are so sure to confront inexperience, will surely triumph.* In-sooth, he who appreciates the beautiful and marvelous, will soon grow to love his companions of the hive, and the labor attendant upon their care and management. Nor will this love abate till it has kindled into enthusiasm.

True, there may be successful apiarists who are impelled by no warmth of feeling, whose superior intelligence, system and promptitude, stand in lieu of and make amends for absence of enthusiasm. Yet I believe such are rare, and certainly they work at great disadvantage.

PART FIRST.

NATURAL HISTORY

OF

THE HONEY BEE.

NATURAL HISTORY OF THE HONEY-BEE.

CHAPTER I.

THE BEE'S PLACE IN THE ANIMAL KINGDOM.

It is estimated by Heer and other eminent naturalists, that there are more than 250,000 species of living animals. It will be both interesting and profitable to look in upon this vast host, that we may know the position and relationship of the bee to all this mighty concourse of life.

BRANCH OF THE HONEY-BEE.

The great French naturalist, Cuvier, a friend of Napoleon I., grouped all animals which exhibit a ring structure into one branch, appropriately named Articulates, as this term indicates the jointed or articulated structure which so obviously characterizes most of the members of this group.

The terms joint and articulation, as used here, have a technical meaning. They refer not only to the hinge or place of union of two parts, but also to the parts themselves. Thus, the parts of an insect's legs, as well as the surfaces of union, are styled joints or articulations. All apiarists who have examined carefully the structure of a bee, will at once pronounce it an Articulate. Not only is its body, even from head to sting, composed of joints, but by close inspection we find the legs, the antennæ, and even the mouth-parts, likewise, jointed.

In this branch, too, we place the Crustacea—which includes the rollicking cray-fish or lobster, so indifferent as to whether he moves forward, backward or sidewise, the shorter crab, the sow-bug, lively and plump, even in its dark, damp home under old boards, etc., and the barnacles, which fasten to the bottom of ships, so that vessels are often freighted with life within and without.

The worms, too, are Articulates, though in some of these, as the leech, the joints are very obscure. The bee, then, which gives us food, is related to the dreaded tape-worm with its hundred of joints, which, mayhaps, robs us of the same

food after we have eaten it, and the terrible pork-worm or trichina, which may consume the very muscles we have developed in caring for our pets of the apiary.

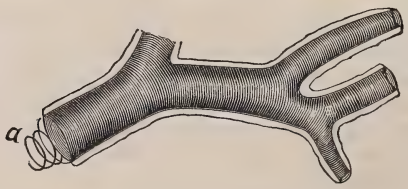
The body-rings of Articulates form a skeleton, firm as in the bee and lobster, or more or less soft as in the worms. This skeleton, unlike that of Vertebrates or back-bone animals, to which we belong, is outside, and thus serves to protect the inner, softer parts, as well as to give them attachment, and to give strength and solidity to the animal.

This ring-structure, so beautifully marked in our golden-banded Italians, usually makes it easy to separate, at sight, animals of this branch from the Vertebrates, with their usually bony skeleton; from the less active Molluscan branch, with their soft, sack-like bodies, familiar to us in the snail, the clam, the oyster, and the wonderful cuttle-fish—the devil-fish of Victor Hugo—with its long, clammy arms, strange ink-bag, and often prodigious size; from the Radiate branch, with its elegant star-fish, delicate but gaudy jelly fish, and coral animals, the tiny architects of islands and even continents; and from the lowest, simplest, Protozoan branch, which includes animals so minute that we owe our very knowledge of them to the microscope, so simple that they have been regarded as the apron-strings which tie plants to animals.

THE CLASS OF THE HONEY-BEE.

Our subject belongs to the class Insecta, which is mainly characterized by breathing air usually through a very complicated system of air-tubes. These tubes (Fig. 1), which are con-

FIG. 1.

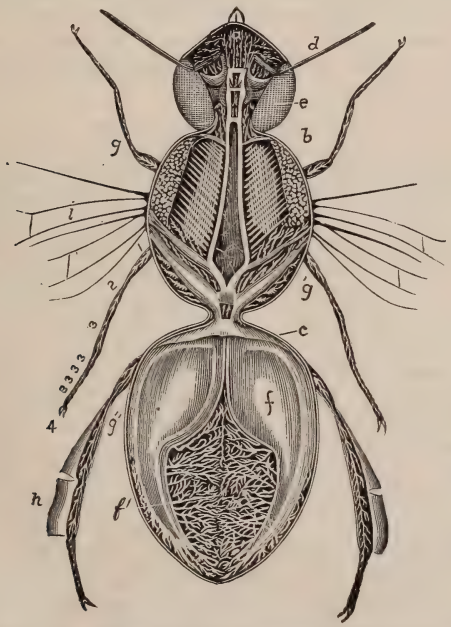


A Trachea, magnified.

stantly branching, and almost infinite in number, are very peculiar in their structure. They are formed of a spiral

thread, and thus resemble a hollow cylinder formed by closely winding a fine wire spirally about a pipe-stem, so as to cover it, and then withdrawing the latter, leaving the wire unmoved. Nothing is more surprising and interesting, than this labyrinth of beautiful tubes, as seen in dissecting a bee under the microscope. I have frequently detected myself taking long pauses, in making dissections of the honey-bee, as my attention would be fixed in admiration of this beautiful breathing apparatus. In the bee these tubes expand into large

FIG. 2.



Respiratory Apparatus of Bee, magnified.—After Duncan.

lung-like sacks (Fig. 2, *f*), one each side of the body. Doubtless some of my readers have associated the quick movements and surprising activity of birds and most mammals with their

well-developed lungs, so, too, in such animals as the bees, we see the relation between this intricate system of air-tubes—their lungs—and the quick, busy life which has been proverbial of them since the earliest time. The class Insecta also includes the spiders, scorpions, with their caudal sting so venomous, and mites, which have in lieu of the tubes, lung-like sacks, and the myriapods, or thousand-legged worms—those dreadful creatures, whose bite, in case of the tropical centipeds or flat species, have a well-earned reputation of being poisonous and deadly.

The class Insecta does not include the water-breathing Crustacea, with their branchiæ or gills, nor the worms, which have no lungs or gills but their skin, if we except some marine forms, which have simple dermal appendages, which answer to branchiæ.

ORDER OF THE HONEY-BEE.

The honey-bee belongs to the order Hexapods, or true Insects. The first term is appropriate, as all have in the imago or last stage, six legs. Nor is the second term less applicable, as the word insect comes from the Latin and means to cut in, and in no other articulates does the ring structure appear so marked upon merely a superficial examination. More than this, the true insects when fully developed have, unlike all other articulates, three well-marked divisions of the body (Fig. 2), namely: the head (Fig. 2, *a*), which contains the antennæ (Fig. 2, *d*), the horn-like appendages common to all insects; eyes (Fig. 2, *e*) and mouth organs; the thorax (Fig. 2, *b*), which bears the legs (Fig. 2, *g*), and wings, when they are present; and lastly, the abdomen (Fig. 2, *c*), which, though usually memberless, contains the ovipositor, and when present, the sting. Insects, too, undergo a more striking metamorphosis than do most animals. When first hatched they are worm-like and called larvæ (Fig. 12), which means masked; afterward they are frequently quiescent, and would hardly be supposed to be animals at all. They are then known as pupæ, or as in case of bees as nymphs (Fig. 13). At last there comes forth the imago with compound eyes, antennæ and wings. In some insects the transformations are said to be incomplete, that is the larva, pupa and imago differ

little except in size, and that the latter possesses wings. We see in our bugs, lice, locusts and grasshoppers, illustrations of insects with incomplete transformations. In such cases there is a marked resemblance from the egg to the adult.

As will be seen by the above description the spiders, which have only two divisions to their bodies, only simple eyes, no antennæ, eight legs, and no transformations (if we except the partial transformations of the mites), as also the myriapods, which have no marked divisions of the body, and no compound eyes—which are always present in the mature insect—many legs and no transformations, do not belong to the order Insects.

SUB-ORDER OF THE HONEY BEE.

The honey bee belongs to the sub-order Hymenoptera (from two Greek words meaning membrane and wings), which also includes the wasps, ants, ichneumon-flies and saw-flies. This group contains insects which possess a tongue by which they may suck (Fig. 21, *a*), and strong jaws (Fig. 22, *c*) for biting. Thus the bees can sip the honeyed sweets of flowers, and also gnaw away mutilated comb. They have, besides, four wings, and undergo complete tranformations.

There are among insects strange resemblances. Insects of one sub-order will show a marked likeness to those of another. This is known as mimicry, and sometimes is wonderfully striking between very distant groups. Darwin and Wallace suppose it is a developed peculiarity, not always possessed by the species, and comes through the laws of variation, and natural selection to serve the purpose of protection. Now, right here we have a fine illustration of this mimicry. Just the other day I received through Mr. A. I. Root, an insect which he and the person sending it to him supposed to be a bee, and desired to know whether it was a mal-formed honey-bee or some other species. Now, this insect, though looking in a general way much like a bee, had only two wings, had no jaws, while its antennæ were closer together in front and mere stubs. In fact, it was no bee at all, but belonged to the sub-order Diptera, or two-wing flies. I have received several similar insects, with like inquiries. Among Diptera there are several families, as the Œstridæ or bot-flies, the Syrphidæ—

a very useful family, as the larvæ or maggots live on plant-lice—whose members are often seen sipping sweets from flowers, or trying to rob honey and other bees—the one referred to above belonged to this family—and the Bombyliidæ, which in color, form and hairy covering are strikingly like wild and domesticated bees. The maggots of these feed on the larvæ of various of our wild bees, and of course the mother fly must steal into the nests of the latter to lay her eggs. So in these cases, there is seeming evidence that the mimicry may serve to protect these fly-tramps, as they steal in to pilfer the coveted sweets or lay the fatal eggs. Possibly, too, they may have a protective scent, as I have seen them enter a hive in safety, though a bumble-bee essaying to do the same, found the way barricaded with myriad cimeters each with a poisoned tip.

Some authors have placed Coleoptera or beetles as the highest of insects, others claim for Lepidoptera or butterflies and moths a first place, while others, and with the best of reasons, claim for Hymenoptera the highest position. The moth is admired for the glory of its coloring and elegance of its form, the beetle for the luster and brilliancy of its elytra or wing-covers; but these insects only revel in nature's wealth, and live and die without labor or purpose. Hymenoptera usually less gaudy, generally quite plain and unattractive in color, are yet the most highly endowed among insects. They live with a purpose in view, and are the best models of industry to be found among animals. Our bees practice a division of labor; the ants are still better political economists, as they have a specially endowed class in the community who are the soldiers, and thus are the defenders of each ant-kingdom. Ants also conquer other communities, take their inhabitants captive and reduce them to abject slavery—requiring them to perform a large portion, and sometimes the whole labor of the community. Ants tunnel streams, and in the tropics some leaf-eating species have been observed to show no mean order of intelligence, as some ascend trees to cut off the leafy twigs, while others remain below, and carry these branches through their tunnels to their under-ground homes.

The parasitic Hymenoptera, are so called because they lay their eggs in other insects, that their offspring may have

fresh meat not only at birth, but so long as they need food, as the insect fed upon generally lives till the young parasite, which is working to disembowel it, is full-grown. Thus this steak is ever fresh as life itself. These parasitic insects show wondrous intelligence, or sense development, in discovering this prey. I have caught ichneumon-flies—a family of these parasites—boring through an eighth or quarter-inch of solid beech or maple wood, and upon examination I found the prospective victim further on in direct line with the insect auger, which was to intrude the fatal egg. I have also watched ichneumon-flies depositing eggs in leaf-rolling caterpillars, so surrounded with tough hickory leaves that the fly had to pierce several thicknesses to place the egg in its snugly-ensconced victim. Upon putting these leaf-rolling caterpillars in a box, I reared, of course, the ichneumon-fly and not the moth. And is it instinct or reason that enables these flies to gauge the number of their eggs to the size of the larva which is to receive them, so that there may be no danger of famine and starvation, for true it is that while small caterpillars will receive but one egg, large ones may receive several. How strange, too, the habits of the saw-fly, with its wondrous instruments more perfect than any saws of human workmanship, and the gall-flies, whose poisonous sting as they fasten their eggs to the oak, willow or other leaves, causes the abnormal growth of food for the still unhatched young. The providing and caring for their young, which are at first helpless, is peculiar among insects, with slight exception, to the Hymenoptera, and among all animals is considered a mark of high rank. Such marvels of instinct, if we may not call it intelligence, such acumen of sense perception, such habits —that *must* go hand-in-hand with the most harmonious of communities known among animals, of whatever branch—all these, no less than the compact structure, small size and specialized organs of nicest finish, more than warrant that grand trio of American naturalists, Agassiz, Dana and Packard, in placing Hymenoptera as first in rank among insects. As we shall detail the structure and habits of the *highest* of the high—the bees—in the following pages, I am sure no one will think to degrade the rank of these wonders of the animal kingdom.

FAMILY OF THE HONEY-BEE.

The honey-bee belongs to the family Apidæ, of Leach, which includes not only the hive bee, but all insects which feed their helpless young, or larvæ, entirely on pollen, or honey and pollen.

The insects of this family have broad heads, elbowed antennæ (Fig. 2, *d*) which are usually thirteen-jointed in the males, and only twelve-jointed in the females. The jaws or mandibles (Fig. 21) are very strong, and often toothed; the tongue or ligula (Fig. 20, *a*), as also the second jaws or maxillæ (Fig. 20, *c*), one each side the tongue, are long, though in some cases much shorter than in others, and frequently the tongue when not in use is folded back, once or more, under the head. All the insects of this family have a stiff spine on all four of the anterior legs, at the end of the tibia, or the third joint from the body, called the tibial spur, and all, except the genus Apis, which includes the honey-bee, in which the posterior legs have no tibial spurs, have two tibial spurs on the posterior legs. All of this family except one parasitic genus, have the first joint or tarsus of the posterior foot, much widened, and this together with the broad tibia (Fig. 2, *h*) is hollowed out (Fig. 22, *p*), forming quite a basin or basket on the outer side, in nearly all the species; and generally, this basket is made deeper by a rim of stiff hairs. These receptacles or pollen baskets are only found of course on such individuals of each community as gather pollen. A few of the Apidæ—thieves by nature—cuckoo-like, steal unbidden into the nests of others, usually bumble-bees, and here lay their eggs. As their young are fed and fostered by another, they gather no pollen, and hence like drone bees need not, and have not pollen baskets. The young of these lazy tramps, starve out the real insect babies of these homes, by eating their food, and in some cases, it is said, being unable like the young cuckoos to hurl these rightful children from the nest, they show an equal if not greater depravity by eating them, not waiting for starvation to get them out of the way. These parasites illustrate mimicry, already described, as they look so like the foster mothers of their own young, that unscientific eyes would often fail to distinguish them.

Probably the bumble-bees are no sharper, or they would refuse ingress to these merciless vagrants.

The larvæ (Fig. 12) of all insects of this family are maggot-like—wrinkled, footless, tapering at both ends, and, as before stated, feed upon pollen and honey. They are helpless, and thus, all during their babyhood—the larvæ state—the time when all insects are most ravenous, and the only time when many insects take food, the time when all growth in size, except such enlargement as is required by egg-development, occurs, these infant bees have to be fed by their mothers or elder sisters. They have a mouth with soft lips, and weak jaws, yet it is doubtful if all or much of their food is taken in at this opening. There is some reason to believe that they, like many maggots—such as the Hessian-fly larvæ—absorb much of their food through the body walls. From the mouth leads the intestine, which has no anal opening. So there is no excreta other than gas and vapor. What commendation for their food, *all* capable of nourishment, and thus all assimilated.

To this family belongs the genus of stingless bees, Melipona, of Mexico and South America, which store honey not only in the hexagonal brood-cells, but in great wax reservoirs. They, like the unkept hive-bee, build in hollow logs. They are exceedingly numerous in each colony, and it has thus been thought that there were more than one queen. They are also very prodigal of wax, and thus may possess a prospective commercial importance in these days of artificial comb-foundation. In this genus the basal joint of the tarsus is triangular, and they have two submarginal cells, not three, to the front wings. They are also smaller than our common bees, and have wings that do not reach to the tip of their abdomens.

Another genus of stingless bees, the genus Trigona, have the wings longer than the abdomens, and their jaws toothed. These, unlike the Melipona, are not confined to the New World, but are met in Africa, India and Australasia. These build their combs in tall trees, fastening them to the branches much as does the Apis dorsata, soon to be mentioned.

Of course insects of the genus Bombus—our common bumble-bees—belong to this family. Here the tongue is very

long, the bee large, the sting curved, with the barbs very short and few. Only the queens survive the winter. In spring she forms her nest under some sod or board, hollowing out a basin in the earth, and after storing a mass of bee-bread—probably a mixture of honey and pollen—she deposits several eggs in the mass. The larvæ so soon as hatched out, eat out thimble-shaped spaces, which in time become even larger, and not unlike in form the queen-cells of our hive-bees. When the bees issue from these cells the same are strengthened by wax. Later in the season these coarse wax cells become very numerous. Some may be made as cells and not formed as above. The wax is dark, and doubtless contains much pollen, as do the cappings and queen-cells of the honey-bees. At first the bees are all workers, later queens appear, and still later males. All, or nearly all, entomologists speak of two sizes of queen bumble-bees, the large and the small. The small appear early in the season, and the large late. A student of our College, Mr. N. P. Graham, who last year had a colony of bumble-bees in his room the whole season, thinks this an error. He believes that the individuals of the Bombus nest exactly correspond with those of the Apis. The queens, like those of bees, are smaller before mating and active laying. May not this be another case like that of the two kinds of worker-bees which deceived even Huber, an error consequent upon lack of careful and prolonged observation?

In Xylocopa or the carpenter-bees, which much resemble the bumble-bees, we have a fine example of a boring insect. With its strong mandibles or jaws it cuts long tunnels, often one or two feet long in the hardest wood. These burrows are divided by chip partitions into cells, and in each cell is left the bee-bread and an egg.

The mason-bee—well named—constructs cells of earth and gravel, which by aid of their spittle they have power to cement, so that they are harder than brick.

The tailor or leaf-cutting bees, of the genus Megachile, make wonderful cells from variously shaped pieces of leaves. These are always mathematical in form, usually circular and oblong, and are cut—by the insect's making scissors of its jaws—from various leaves, the rose being a favorite. I have found these cells made almost wholly of the petals or flower

leaves of the rose. The cells are made by gluing these leaf-sections in concentric layers, letting them over-lap. The oblong sections form the walls of the cylinder, while the circular pieces are crowded as we press circular wads into our shot-guns, and are used at the ends or for partitions where several cells are placed together. When complete, the single cells are in form and size much like a revolver cartridge. When several are placed together, which is usually the case, they are arranged end to end, and in size and form are quite like a small stick of candy, though not more than one-third as long. These cells I have found in the grass, partially buried in the earth, in crevices, and in one case knew of their being built in the folds of a partially-knit sock, which a good house-wife had chanced to leave stationary for some days. These leaf-cutters have rows of hairs underneath, with which they carry pollen. I have noticed them each summer for some years swarming on the Virginia creeper, often called woodbine, while in blossom, in quest of pollen, though I never saw a single hive-bee on these vines. The tailor-bees often cut the foliage of the same vines quite badly.

I have often reared beautiful bees of the genus Osmia, which are also called mason-bees. Their glistening colors of blue and green possess a luster and reflection unsurpassed even by the metals themselves. These rear their young in cells of mud, in mud-cells lining hollow weeds and shrubs, and in burrows which they dig in the hard earth. In early summer, during warm days, these glistening gems of life are frequently seen in walks and drives intent on gathering earth for mortar, or digging holes, and will hardly escape identification by the observing apiarist, as their form is so much like that of our honey-bees. They are smaller; yet their broad head, prominent eyes, and general form, is very like that of the equally quick and active, yet more soberly attired, workers of the apiary.

Other bees—the numerous species of the genus Nomada, and of Apathus, are the black sheep in the family Apidæ. These tramps, already referred to, like the English cuckoo and our American cow-blackbird, steal in upon the unwary, and, though all unbidden, lay their eggs; in this way appropriating food and lodgings for their own yet unborn. Thus

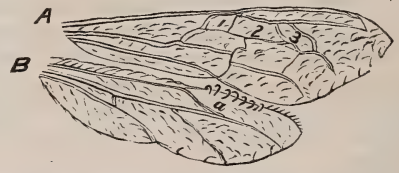
these insect vagabonds impose upon the unsuspecting foster-mothers in these violated homes. And these same foster-mothers show by their tender care of these merciless intruders, that they are miserably fooled, for they carefully guard and feed infant bees, which with age will in turn practice this same nefarious trickery.

I reluctantly withhold further particulars of this wonderful bee family. When first I visited Messrs. Townley and Davis, of this State, I was struck with the fine collection of wild bees which each had made. Yet, unknowingly, they had incorporated many that were not bees. Of course, many apiarists will wish to make such collections and also to study our wild bees. I hope the above will prove efficient aid. I hope, too, that it will stimulate others, especially youth, to the valuable and intensely interesting study of these wonders of nature. I am glad, too, to open to the reader a page from the book of nature so replete with attractions as is the above. Nor do I think I have taken too much space in revealing the strange and marvelous instincts, and wonderfully varied habits, of this highest of insect families, at the head of which stand our own fellow-laborers and companions of the apiary.

THE GENUS OF THE HONEY-BEE.

The genus Apis includes all bees that have no tibial spurs on the posterior legs. They have three cubital or sub-costal cells (1, 2, 3, Fig. 3)—the second row from the costal or anterior

FIG. 3.



A.—*Anterior Wing of a Bee.* 1, 2, 3.—*Sub-costal or Cubital Cells.*
B.—*Secondary or Posterior Wing, a hooks to attach to Primary Wing.*

edge—on the front or primary wings. On the inner side of the posterior basal tarsus, opposite the pollen baskets, in the neuters or workers, are rows of hairs (Fig. 23) which are probably used in collecting pollen. In the males, which do no

work except to fertilize the queens, the large compound eyes meet above, crowding the three simple eyes below (Fig. 4),

FIG. 4.



Head of Drone, magnified.

Antennæ. Compound Eyes. Simple Eyes.

while in the workers (Fig. 5) and queens these simple eyes, called ocelli (Fig. 5), are above, and the compound

FIG. 5.



Head of Worker, magnified.

Antennæ. Compound Eyes. Simple Eyes.

eyes (Fig. 5) wide apart. The queens and drones have weak jaws, with a rudimentary tooth (Fig. 21, *b*), short tongues, and no pollen baskets, though they have the broad tibia and wide basal tarsus (Fig. 16, *p*).

There is some doubt as to the number of species of this genus. It is certain that the Apis ligustica of Spinola, or

Italian bee, the Apis fasciata of Latreille, or Egyptian bee, are only varieties of the Apis Mellifica, which also includes the German or black bee.

Mr. F. Smith, an able entomologist, considers Apis dorsata of India and the East Indies, Apis zonata of the same islands, Apis Indica of India and China, and Apis florea of India, Ceylon, China and Borneo, as distinct species. He thinks, also, that Apis Adansoni and Apis nigrocincta are distinct, but thinks they may be varieties of Apis Indica. Some regard Apis unicolor as a distinct species, but it is probably a variety of Apis dorsata. As Apis Mellifica has not been found in India, and is a native of Europe, Western Asia and Africa, it seems quite probable that several of the above may turn out to be only varieties of Apis Mellifica. If there are only color and size to distinguish them, and, indeed, one may add habits, then we may suspect, with good reason, the validity of the above arrangement. If there is structural difference, as Mr. Wallace says there is, in the male dorsata, then we may call them different species. The Italian certainly has a longer tongue than the German, yet that is not sufficient to separate them as species. Apis zonata and Apis unicolor, both of the East Indies, are said to be very black. Apis dorsata is large, suspends its combs to the branches of trees—in rare cases our own bees have been known to do the same—is said to be cross, to have a very long tongue, to be larger than our common bees, and to make larger cells.

Apis Florea is small, only half as large as Apis Mellifica, of different form, while the posterior tarsus of the male is lobed.

It would be very interesting, and perhaps profitable, to import these various species, and see how marked is the difference between them and ours. Such work can be best accomplished through our National Association. Very likely, as we come to know these far-off bees as we know the German and Italian, we shall find that their amiability, size, habits of comb-building, and lengthened organs, are only peculiarities developed by climate and surrounding conditions, and shall sweep them all into the one species, Apis Mellifica, to be regarded as we now regard the Italian and Egyptian, as only varieties.

It seems strange that the genus Apis should not have been

native to the American continent. Without doubt there were no bees of this genus here till introduced by the Caucasian race. It seems more strange, as we find that all the continents and islands of the Eastern hemisphere abound with representatives. It is one more illustration of the strange, inextricable puzzles connected with geographical distribution of animals.

SPECIES OF OUR HONEY-BEES.

The bees at present domesticated unquestionably belong to the Apis Mellifica. The characters of this species will appear in the next chapter, as we proceed with their anatomy and physiology. As before stated, this species is native exclusively to the Eastern hemisphere, though it has been introduced wherever civilized man has taken up his abode.

VARIETIES OF THE HONEY-BEE.

GERMAN OR BLACK BEE.

The German or black bee is the variety best known, as through all the ages it has been most widely distributed. The name German refers to locality, while the name black is a misnomer, as the bee is a gray-black. The queen, and in a less degree the drones, are darker, while the legs and under surface of the former is brown, or copper color, and of the latter light-gray. The tongue of the black workers I have found, by repeated dissections and comparisons made both by myself and by my pupils, is shorter than that of the Italian workers, and generally less hairy. The black bees have been known no longer than the Italians, as we find the latter were known both to Aristotle, the fourth century B. C., and to Virgil, the great Roman poet, who sung of the variegated golden bee, the first century B. C. ; and we can only account for the wider distribution of the German bee by considering the more vigorous pushing habits of the Germanic races, who not only over-ran and infused life into Southern Europe, but have vitalized all christendom.

LIGURIAN OR ITALIAN BEE.

The Italian bee (see frontis-plate) is characterized as a variety, not only by difference of color, habits, and activity, but also by possessing a little longer tongue. These bees were first described as distinct from the German race by Spinola, in

1805, who gave the name Ligurian bee, which name prevails in Europe. The name comes from a province of Northern Italy, north of the Ligurian Gulf, or Gulf of Genoa. This region is shut off from Northern Europe by the Alps, and thus these bees were kept apart from the German bees, and in warmer, more genial Italy, was developed a distinct race, our beautiful Italians.

In 1843, Von Baldenstein procured a colony of these bees, which he had previously observed as peculiar, while stationed as a military captain in Italy. He published his experience in 1848, which was read by Dzierzon, who became interested, and through him the Italian became generally introduced into Germany. In 1859, six years after Dzierzon's first importation, the Italian variety was introduced into England by Neighbour, the author of the valuable treatise already referred to. The same year, Messrs Wagner and Colvin imported the Italians from Dzierzon's apiary into America; and in 1860, Mr. S. P. Parsons brought the first colonies that were imported direct from Italy.

The Italian worker (see frontis-plate) is quickly distinguished by the bright-yellow rings at the base of the abdomen. If the colony is pure, every bee will show three of these golden girdles. The two first segments or rings of the abdomen, except at their posterior border, and also the base or anterior border of the third, will be of this orange-yellow hue. The rest of the back or dorsal surface will be much as in the German race. Underneath the abdomen, except for a greater or less distance at the tip, will also be yellow, while the same color appears more or less strongly marked on the legs. The workers, too, have a longer ligula or tongue (Fig. 20) than do the German race, which is usually a little more hairy. They are also more active, and less inclined to sting.

The queen has the entire base of her abdomen, and sometimes nearly the whole of it, orange-yellow. The variation as to amount of color in the queens, is quite striking. Sometimes very dark queens are imported right from the Ligurian hills, yet all the workers will wear the badge of purity—the three golden bands.

The drones, too, are quite variable. Sometimes the rings and patches of yellow will be very prominent, then, again,

quite indistinct. But the underside of the body is always, so far as I have observed, mainly yellow.

THE FASCIATA OR EGYPTIAN RACE.

The word fasciata means banded, as the Egyptian bee is very broadly banded with yellow. I have never seen these bees, but from descriptions by Latrielle, Kirby, and Bevan, I understand that all the bees are rather smaller, more slim, and much more yellow than the Italians. Herr Vogel states that they gather no propolis, but that each colony contains a number of small drone-laying queens. These bees were probably the ones which, with the kine of the ancient goodly land of promise, gave the rich pabulum, that gave the reputation: "flowing with milk and honey." They are thus the oldest of domesticated bees. These, too, are said to have been moved in rude boats or rafts up and down the Nile, as the flower pasturage seemed to require. The bees are said to be very active, to be proof against the cold, and have also been reputed very cross.

OTHER VARIETIES.

There are several other doubtful varieties which are receiving some attention from the German apiarists, and are honored with attention at the great meetings of Austria and Germany, as we learn from the bee-publications of those countries. The Cyprian bee, from the Isle of Cyprus, as its name indicates, is yellow, and probably an offspring from the Italian or Egyptian. So far as we can learn, it has no merits which will make it preferred to the Italian. Some say it is more beautiful, others that it is less amiable. Other varieties, which are not probably distinct races, or at least may not be, are the Heath, the Carniolan, the Krainer and the Herzegovinian. They are not considered superior to the German and Italian.

A variety of our Italian which has rows of white hairs unusually distinct, is being sold in the United States under the name of Albinos. That they are a distinct race is not at all likely. In fact, I have noticed among our Italian stocks every year, the so-called Albinos.

BIBLIOGRAPHY.

It would be a pleasing duty, and not an unprofitable one, to give in this connection a complete history of entomology so far as it relates to Apis Mellifica. Yet, this would take much space, and as there is quite a full history in books that I shall recommend to those who are eager to know more of this interesting department of natural history, I will not go into details.

Aristotle wrote of bees more than three hundred years B. C. About three hundred years later, Virgil, in his fourth Georgic, gave to the world the views then extant on this subject, gathered largely from the writings of Aristotle. The poetry will ever be remarkable for its beauty and elegance—would that as much could be said for the subject matter, which, though full of interest, is also full of errors. A little later Columella, though usually careful and accurate in his observations, still gave voice to the prevailing errors, though much that he wrote was valuable, and more was curious. Pliny, the Elder, who wrote in the first century A. D., helped to continue the erroneous opinions which previous authors had given, and not content with this, he added opinions of his own, which were not only without foundation, but were often the perfection of absurdity.

After this, nearly two thousand years passed with no progress in natural history; even for two centuries after the revival of learning, we find nothing worthy of note. Swammerdam, a Dutch entomologist, in the middle of the 17th century, wrote a general history of insects, also, "The Natural History of Bees." He and his English cotemporary, Ray, showed their ability as naturalists by founding their systems on the insect transformations. They also revived the study and practice of anatomy, which had slept since its first introduction by Aristotle, as the great stepping-stone in zoological progress. Ray also gave special attention to Hymenoptera, and was much aided by Willoughby and Lister. At this time Harvey, so justly noted for his discovery of the circulation of the blood, announced his celebrated dictum, "Omnia ex ovo," —all life from eggs—which was completely established by the noted Italians, Redi and Malpighi. Toward the middle

of the 18th century, the great Linnæus—"the brilliant Star of the North"—published his "Systema Naturæ," and threw a flood of light on the whole subject of natural history. His division of insects was founded upon presence or absence, and characters, of wings. This, like Swammerdam's basis, was too narrow, yet his conclusions were remarkably correct. Linnæus is noted for his accurate descriptions, and especially for his gift of the binomial method of naming plants and animals, giving in the name the genus and species, as, Apis Mellifica. He was also the first to introduce classes and orders, as we now understand them. When we consider the amount and character of the work of the great Swede, we can but place him among the first, if not as the first, of naturalists. Cotemporary with Linnæus (also written Linné) was Geoffroy, who did valuable work in defining new genera. In the last half of the century appeared the great work of a master in entomology, DeGeer, who based his arrangement of insects on the character of wings and jaws, and thus discovered another of nature's keys to aid him in unlocking her mysteries. Kirby well says: "He united in himself the highest merit of almost every department of entomology." As a scientist, an anatomist, a physiologist, and as the observant historian of the habits and economy of insects, he is above all praise. What a spring of self-improvement, enjoyment and of public usefulness, is such an ability to observe as was possessed by the great DeGeer.

Contemporary with Linnæus and DeGeer was Réaumur, of France, whose experiments and researches are of special interest to apiarists. Perhaps no entomologist has done more to reveal the natural history of bees. Especially to be commended are his method of experimenting, his patience in investigation, the elegance and felicity of his word pictures, and, above all, *his devotion to truth.* We shall have occasion to speak of this conscientious and indefatigable worker in the great shop of insect-life frequently in the following pages. Bonnet, of Geneva, the able correspondent of Réaumur, also did valuable work, in which the lover of bees has a special interest. Bonnet is specially noted for his discovery and elucidation of parthenogenesis—that anomalous mode of reproduction—as it occurs among the Aphides or plant-lice,

though he did not discover that our bees, in the production of drones, illustrate the same doctrine. Though the author of no system, he gave much aid to Réaumur in his systematic labors.

At this same period systematic entomology received great aid from Lyonnet's valuable work. This author dissected and explained the development of a caterpillar. His descriptions and illustrations are wonderful, and will proclaim his ability as long as entomology is studied, and they, to quote Bonnet, "demonstrate the existence of God."

We have next to speak of the great Dane, Fabricius—a student of Linnæus—who published his works from 1775 to 1798, and thus was revolutionizing systematic entomology at the same time that we of America were revolutionizing government. He made the mouth organs the basis of his classification, and thus followed in the path which DeGeer had marked out, though it was scarcely beaten by the latter; while Fabricious left it wide and deep. His classes and orders are no improvement, in fact, are not as nearly correct, as his old master's. In his description of genera—where he pretended to follow nature—he has rendered valuable service. In leading scientists to study parts, before little regarded, and thus to better establish affinities, he did a most valuable work. His work is a standard, and should be thoroughly studied by all entomologists.

Just at the close of the last century, appeared the greatest "Roman of them all," the great Latreille, of France, whose name we have so frequently used in the classification of the honey-bee. His is called the Elective System, as he used wings, mouth-parts, transformations, in fact, all the organs—the entire structure. He gave us our Family Apidæ, our genus Apis, and, as will be remembered, he described several of the species of this genus. In our study of this great man's work, we constantly marvel at his extensive researches and remarkable talents. Lamark, of this time, except that he could see no God in nature, did very admirable work. So, too, did Cuvier, of Napoleon's time, and the learned Dr. Leach, of England. Since then we have hosts of workers in this field, and many worthy of not only mention but praise; yet the work has been to rub up and garnish,

rather than fundamental. So I will close this brief history with a notice of authors who are very serviceable to such as may desire to glean farther of the treasures of systematic entomology. Only remarking that at the end of the next chapter I shall refer to those who have been particularly serviceable in developing the anatomy and physiology of insects, especially of bees.

VALUABLE BOOKS FOR THE STUDENT OF ENTOMOLOGY.

For mere classification, no work is equal to Westwood on Insects—two volumes. In this the descriptions and illustrations are very full and perfect, making it easy to study the families, and even genera, of all the sub-orders. This work and the following are out of print, but can be got with little trouble at second-hand book-stores.

Kirby and Spence—Introduction to Entomology—is a very complete work. It treats of the classification, structure, habits, general economy of insects, and gives a history of the subject. It is an invaluable work, and a great acquisition to any library.

Dr. Packard's Guide to the Study of Insects is a valuable work, and being American, is specially to be recommended.

The Reports of Dr. T. Harris, Dr. A. Fitch, and of Prof. C. V. Riley, will also be found of great value and interest.

I make no apology for this somewhat long discussion, as it is good to hear of those grand men, who have swung wide open the long-closed gates to nature's secrets, and in so doing have not only advanced to an astonishing degree our temporal interests, but have made us co-laborers with them in the glorious work of studying into those hidden secrets, fresh from creative power, and thus partakers of that God-given feast which ministers as nothing else can to the mind and soul of him who partakes in the humble and teachable spirit, which ever characterizes the devout and reverent student of nature.

CHAPTER II.

ANATOMY AND PHYSIOLOGY.

In this chapter I shall give first the general anatomy of insects; then the anatomy, and still more wonderful physiology of the honey-bee.

ANATOMY OF INSECTS.

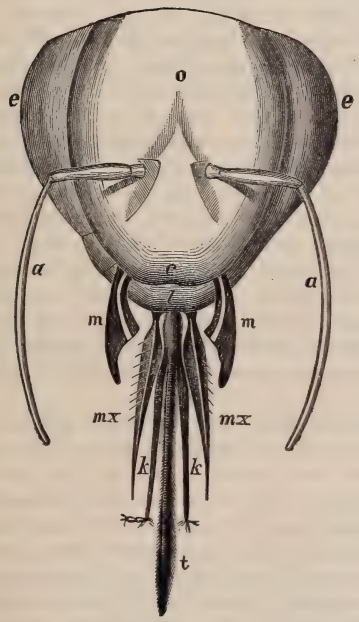
In all insects the body is divided into three well-marked portions (Fig. 2), the head (Figs. 4 and 5), which contains the mouth-organs, the eyes, both the compound and when present the simple, and the antennæ; the thorax, which is composed of three rings, and gives support to the one or two pairs of wings, and to the three pairs of legs; and the abdomen, which is composed of a variable number of rings, and gives support to the external sex-organs, and when present to the sting. Within the thorax there is little more than muscles, as the concentrated strength of insects, which enables them to fly with such rapidity, dwells in this confined space. Within the abdomen, on the other hand, are the sex-organs, by far the greater and more important portions of the alimentary canal, and other important organs.

ORGANS OF THE HEAD.

Of these the mouth-organs (Fig. 6) are most prominent. These consist of an upper lip—labrum—and under lip—labium—and two pairs of jaws which move sidewise; the stronger, horny jaws, called mandibles, and the more membranous, but usually longer, maxillæ. The labrum (Fig. 6, *l*) is well described in the name upper lip. It is attached, usually, by a movable joint to a similar-shaped piece above it, called clypeus (Fig. 6, *c*), and this latter to the broad epicranium (Fig. 6, *o*), which contains the antennæ, the compound, and, when present, the simple eyes.

The labium (Fig. 15) is not described by the name under lip, as its base forms the floor of the mouth, and its tip the tongue. The base is usually broad, and is called the mentum, and from this extends the tongue (Fig. 15, *a*) or ligula.

FIG. 6.



Head of Bee much magnified.

o—Epicranium.
e e—Compound eyes.
a a—Antennæ.
c—Clypeus.
l—Labrum.
m—Jaws.
m x—2d Jaws.
k k—Labial palpi.
t—Ligula.

On either side, near the junction of the ligula and mentum arises a jointed organ rarely absent, called the labial palpus (Fig. 6, *kk*), or, together, the labial palpi. Just within the angle formed by these latter and the ligula arise the paraglossæ (Fig. 15, *d*), one on either side. These are often wanting.

The jaws or mandibles (Fig. 6, *m*, *m*) arise one on either side just below and at the side of the labrum, or upper lip. These work sidewise instead of up and down as in higher animals, are frequently very hard and sharp, and sometimes armed with one or more teeth. A rudimentary tooth (Fig. 21, *b*) is visible on the jaws of drone and queen bees.

Beneath the jaws or mandibles, and inserted a little farther back, are the second jaws or maxillæ (Fig. 6, *mx*), less dense and firm than the mandibles, but far more complex. They arise by a small joint, the cardo, next this is a larger joint, the stipes, from this extends on the inside the broad lacinia (Fig. 20, *c*) or blade, usually fringed with hairs on its inner edge, towards the mouth ; while on the outside of the stipes are inserted the—from one to several jointed—maxillary palpi. In bees these are very small, and consist of two joints, and in some insects are wholly wanting. Sometimes, as in some of the beetles, there is a third member running from the stipes between the palpus and lacinia called the galea. The maxillæ also move sideways, and probably aid in holding and turning the food while it is crushed by the harder jaws, though in some cases they, too, aid in triturating the food.

These mouth parts are very variable in form in different insects. In butterflies and moths, two-wing flies and bugs, they are transformed into a tube, which in the last two groups form a hard, strong beak or piercer, well exemplified in the mosquito and bed-bug. In all the other insects we find them much as in the bees, with the separate parts varying greatly in form, to agree with the habits and character of their possessors. No wonder DeGeer and Fabricius detected these varying forms as strongly indicative of the nature of the insect, and no wonder, too, that in their use they were so successful in forming a natural classification.

Every apiarist will receive great benefit by dissecting these parts and studying their form and relations for himself. By getting his children interested in the same, he will have conferred upon them one of the rarest of blessings.

To dissect these parts, first remove the head and carefully pin it to a cork, passing the pin through, well back between the eyes. Now separate the parts by two needle points, made

by inserting a needle for half its length into a pine stick the shape of a pipe-stem, leaving the point projecting for an inch or more. With one of these in each hand commence operations. The head may be either side up. Much may be learned in dissecting large insects, even with no glass; but in all cases, and especially in small insects, a good lens will be of great value. The best lens is one of Tolles', sold by Mr. Stoddard, of the Boston optical works. These are very excellent and thus high priced, costing $14.00. Gray's triplet hand-lenses are very good, are cheap, and can be procured for about $2.00 of any optician. The handle should have a hole through it to permit of mounting it above the object, so that it will hold itself. Tolles' lenses are easily mounted, in a stand which any one can contrive and make in twenty minutes. I value my Tolles' lens even more highly than my large compound microscope, which cost $150. Were I obliged to part with either, the latter would go.

I require my students to do a great deal of dissecting, which they enjoy very much and find very valuable. I would much rather that my boy would become interested in such study, than to have him possessor of infinite gold rings, or even a huge gold watch, with a tremendous charm. Let such pleasing recreation gain the attention of our boys, and they will ever contribute to our delight, and not sadden us with anxiety and fear.

The antennæ (Fig. 6, *a*, *a*) are the horn-like jointed organs situated between or below and in front of the large compound eyes of all insects. They are sometimes short, as in the house-fly, and sometimes very long, as in the grasshoppers. They are either straight, curved or elbowed (Fig. 6). In form, too, they are very various, as thread-like, tapering, toothed, knobbed, fringed, feathered, etc. It is known that a nerve passes into the antennæ, but their exact function is little understood. That they serve as most delicate touch organs no apiarist can doubt. That they serve as organs of smell or hearing is not proved. That insects are conscious of sounds I think no observing person can doubt. It is proved by the call of the katy-did, the cicada and the cricket. What apiarist, too, has not noticed the effect of various sounds made by the bees upon their comrades of the hive. How contagious

the sharp note of anger, the low hum of fear, and the pleasant tone of a new swarm as they commence to enter their new home. Now, whether insects take note of these vibrations, as we recognize pitch, or whether they just distinguish the tremor, I think no one knows. There is some reason to believe that their delicate touch-organs may enable them to discriminate between vibrations, even more acutely, than can we by use of our ears. A slight jar will quickly awaken a colony of hybrids, while a loud noise will pass unnoticed. If insects can appreciate with great delicacy the different vibratory conditions of the air by an excessive development of the sense of touch, then undoubtedly the antennæ may be great aids. Dr. Clemens thought that insects could only detect atmospheric vibrations. So, too, thought Linnæus and Bonnet. Siebold thinks, as the antennæ receive but one nerve, and are plainly touch-organs, they cannot be organs of hearing. Kirby has noticed that some moths turn their antennæ towards the direction from which noise proceeds, and thus argues that antennæ are organs of hearing. Grote, for a similar reason, thinks that the densely feathered antennæ of the males of various night moths, serve both for smell and hearing. Prof. A. M. Mayer and Mr. C. Johnson (see American Naturalist, vol. 8, p. 574) have by various ingenious experiments, proved conclusively, that the delicate, beautifully feathered antennæ of the male mosquito are organs of hearing.

That insects have a very refined sense of smell is beyond question. How quickly the carrion-fly finds the carcass, the scavenger the filth, and the bee the precious nectar.

I have reared female moths in my study, and have been greatly surprised on the day of their leaving their cocoons, to find my room swarming with males. These bridegrooms entered an open window in the second-story of a brick building. How delicate must have been the sense by which they were led to make the visit, and thus made to grace my cabinet. Bees, too, have been known to dash against a shutter behind which were flowers, thus showing the superiority of their perception of odors, as also their poor vision. But odors are carried by the air, and must reach the insect through this medium. Is it not probable, that the various breathing mouths of insects are also so many noses, and that their delicate

lining membranes abounding with nerve filaments, are the great odor sentinels? This view was maintained by both Lehman and Cuvier, and explains this delicate perception of scents, as the breathing mouths are large and numerous, and most so in insects like bees and moths, which are most sensitive to odors. How quickly the bees notice the scent of a strange bee or queen, or the peculiar odor of the venom. I have known a bee to sting a glove, and in a trice the glove would be as a pin-cushion, with stings in lieu of pins. Sometimes the bees will dart for many feet, guided by this odor. Yet the odor is very pungent, as I have frequently smelt the poison before I would feel the sting. I have tried the experiments of Huber and Lubbock, and know that such insects as bees and ants will take no note of food after the loss of their antennæ. But we must remember that this is a capital operation. With loss of antennæ, insects lose control of their motions, and in many ways show great disturbance. Is it not probable then that removing the antennæ destroys the desire for food, as does amputation with ourselves? Kirby believes with Huber, that there is a scent organ. Huber's experiments on which he based this opinion are, as usual, very interesting. He presented a coarse hair dipped in oil of turpentine—a substance very repugnant to bees—to various parts of a bee engrossed in sipping honey. The bee made no objection, even though it touched the ligula, until it approached the mouth above the mentum, when she became much disturbed. He also filled a bee's mouth with paste, which soon hardened, after which the bee paid no heed to honey placed near it. This was not so conclusive, as the bee may have been so disturbed as to lose its appetite. I have experimented a good deal, and am inclined to the following opinion: The antennæ are very delicate touch-organs or feelers, and are so important in their function and connection that removal produces a severe shock, but further we know but little about their function, if they have other, and from the very nature of the problem we will find it very difficult of solution.

The eyes are of two kinds, the compound, which are always present in mature insects, and the ocelli or simple eyes, which may or may not be present. When present there are usually three, which if we join by lines, we will describe a

triangle, in the vertices of whose angles are the ocelli. Rarely there are but two ocelli, and very rarely but one.

The simple eyes (Fig. 4, *fff*) are circular, and possess a cornea, lens and retina, which receives the nerve of sight.

From the experiments of Réaumur and Swammerdam, which consisted in covering the eyes with varnish, they concluded that vision with these simple eyes is very indistinct, though by them the insect can distinguish light. Some have thought that these simple eyes were for vision at slight distances. Larvæ, like spiders and myriapods, have only simple eyes.

The compound eyes (Fig. 2, *e*) are simply a cluster of simple eyes, are situated one on either side of the head, and vary much in form and size. Between or below these are inserted the antennæ. Sometimes these last are inserted in a notch of the eyes, and in a few cases actually divide each eye into two eyes.

The eyes may meet above as in drones (Fig. 4), most two-wing flies and dragon-flies, or they may be considerably separated, as in the worker-bees (Fig. 5). The separate facets or simple eyes, of each compound eye are hexagonal, or six-sided, and in the microscope look not unlike a section of honey-comb. The number of these is prodigious—Leeuwenhoek actually counted 12,000 in the eye of a dragon-fly—while some butterflies have over 17,000. The compound eyes are motionless, but from their size and sub-spherical shape, they give quite a range of vision. It is not likely that they are capable of adjustment to accord with different distances, and it has been supposed, from the direct darting flight of bees to their hives, and the awkward work they make in finding a hive when moved only for a short distance, that their eyes are best suited to long vision.

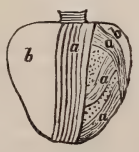
Sir John Lubbock has proved, by some interesting experiments with strips of colored paper, that bees can distinguish colors. Honey was placed on a blue strip, beside several others of various colors. In the absence of the bees he changed the position of this strip, and upon their return the bees went to the blue strip rather than to the old position. Our practical apiarists have long been aware of this fact, and have conformed their practice to the knowledge, in giving a variety of

colors to their hives. Apiarists have frequently noted that bees have a rare faculty of marking positions, but for slight distances, their sense of color will correct mistakes which would occur if position alone was guide.

APPENDAGES OF THE THORAX.

The organs of flight are the most noticeable appendages of the thorax. The wings are usually four, though the Diptera have but two, and some insects—as the worker ants—have none. The front or primary wings (Fig. 3, *A*) are usually larger than the secondary or hind wings (Fig. 3, *B*), and thus the mesathoracic or middle ring of the thorax, to which they are attached, is usually larger than the mettathorax or third ring. The wings consist of a broad frame-work of veins (Fig. 3), covered by a thin, tough membrane. The main ribs or veins are variable in number, while towards the extremity of the wing are more or less cross-veins, dividing this portion of the wings into more or less cells. In the higher groups these cells are few, and quite important in classifying. Especially useful are the cells in the second row, from the frontal or costal edge of the front wings, called the sub-costal cells. Thus in the genus Apis there are three such cells (Fig. 3, *A*, 1, 2, 3), while in the Melipona there are only two. The ribs

FIG. 7.



Thorax of Bee magnified three times.

a, a, a—Muscles. *b, b*—Crust.

or veins consist of a tube within a tube. The inner one forming an air tube, the outer one carrying blood. On the costal edge of the secondary wings we often find hooks, to attach it to the front wings (Fig. 3, *B*, *a*).

The wings are moved by powerful muscles, compactly located in the thorax (Fig. 7, *a*, *a*, *a*), whose strength, as well as the rapidity of the vibrations of the wings when flight is rapid,

are really beyond computation. Think of a tiny fly outstripping the fleetest horse in the chase, and then marvel at this wondrous mechanism.

The legs (Fig. 2, *g, g, g*) are six in number in all mature insects, two on the lower side of each ring of the thorax. These are long or short, weak or strong, according to the habit of the insect. Each leg consists of the following joints or parts: The coxæ (Fig. 24), which move like a ball and socket joint in the close-fitting coxal cavities of the body-rings. Next to these follow in order the broad tracanter, the large, broad femur (Fig. 2, *g'*, 1), the long, slim tibia (Fig. 2, *g'*, 2), frequently bearing strong spines at or near its end, called tibial spurs, and followed by the from one to five-jointed tarsi (Fig. 2, *g'*, 3, 3, 3, 3, 3). All these parts move freely upon each other, and will vary in form to agree with their use. At the end of the last tarsal joint are two hooked claws (Fig. 2, *g'*, 4), between which are the pulvilli, which are not air-pumps as usually described, but rather glands, which secrete a sticky substance which enables insects to stick to a smooth wall, even though it be above them. The legs, in fact the whole crust, is more or less dense and hard, owing to the deposit within the structure of a hard substance known as chitine.

INTERNAL ANATOMY OF INSECTS.

The muscles of insects are usually whitish. Sometimes I have noticed quite a pinkish hue about the muscles of the thorax. They vary in form and position to accord with their use. The mechanism of contraction is the same as in higher animals. The ultimate fibers of the voluntary muscles, when highly magnified, show the striæ or cross-lines the same as do the voluntary muscles of vertebrates, and are very beautiful as microscopic objects. The separate muscles are not bound together by a membrane as in higher animals. In insects the muscles are widely distributed, though, as we should expect, they are concentrated in the thorax and head. In insects of swiftest flight, like the bee, the thorax (Fig. 7, *a, a, a*) is almost entirely composed of muscles; the œsophagus, which carries the food to the stomach, being very small. At the base of the jaws, too, the muscles are large and firm.

The number of muscles is astounding. Lyonnet counted over 3,000 in a single caterpillar, nearly eight times as many as are found in the human body. The strength, too, of insects is prodigious. There must be quality in muscles, for muscles as large as those of the elephant, and as strong as those of the flea, would not need the fulcrum which the old philosopher demanded, in order to move the world. Fleas have been made to draw miniature cannon, chains, and even wagons many hundred times heavier than themselves.

The nerves of insects are in no wise peculiar so far as known, except in position. As in our bodies, some are knotted or have ganglia, and some are not.

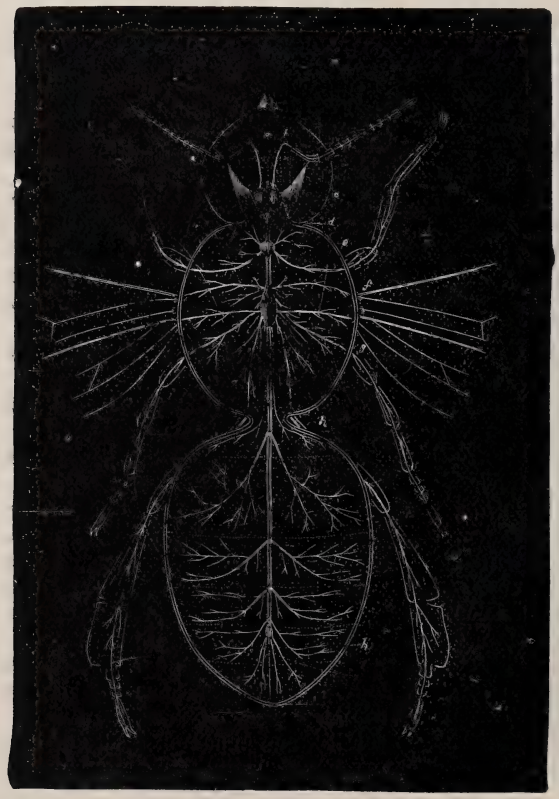
The main nervous cord runs along the under or ventral side of the body (Fig. 8), separates near the head, and after passing around the œsophagus, enlarges to form the largest of the ganglia, which serves as a brain. The minute nerves extend everywhere, and in squeezing out the viscera of an insect are easily visible.

The organs of circulation in insects are quite insignificant. The heart is a long tube situated along the back, and receives the blood at valvular openings along its sides which only permit the fluid to pass in, when by contraction it is forced towards the head and emptied into the general cavity. Thus the heart only serves to keep the blood in motion. According to the best authorities, there are no special vessels to carry the blood to various organs. Nor are they necessary, as this nutritive fluid everywhere bathes the alimentary canal, and thus easily receives nutriment, or gives waste by osmosis. Everywhere surrounds the tracheæ or air-tubes—the insect's lungs—and thus receives that most needful of all food, oxygen, and gives the baneful carbonic acid, everywhere touches the various organs, and gives and takes as the vital operations of the animal require.

The blood is light colored, and almost destitute of discs or corpuscles, which are so numerous in the blood of higher animals, and which give our blood its red color. The function of these discs is to carry oxygen, and as oxygen is carried everywhere through the body by the ubiquitous air-tubes of insects, we see the discs are not needed. Except these semi-fluid discs, which are real organs, and nourished as are other

organs, the blood of higher animals is entirely fluid, in all normal conditions, and contains not the organs themselves or any part of them, but only the elements, which are absorbed

FIG. 8.



Nervous System of the Drone magnified four times.

by the tissue and converted into the organs, or, to be scientific, are assimilated. As the blood of insects is nearly des-

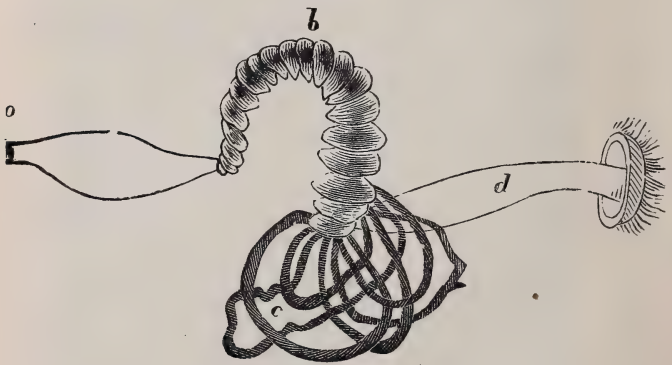
titute of these discs, it is almost wholly fluid, and is almost wholly made up of nutritious substance.

The respiratory or breathing system of insects has already been referred to. Along the sides of the body are the spiracles or breathing mouths, which vary in number. These are armed with a complex valvular arrangement which precludes dust or other noxious particles. These spiracles are lined with a delicate membrane which abounds with nerves, which were referred to in speaking of them as smelling organs. From these extend the labyrinth of air-tubes (Fig. 2, *f*, *f'*), which breathe vitalizing oxygen into every part of the insect organism. In the more active insects—as in bees—the main tracheæ, one on each side of the abdomen, are expanded into large air-sacks (Fig. 2, *f*). Insects often show a respiratory motion, which in bees is often very marked. Newport has shown that in bees the rapidity of the respiration gauges the heat in the hive, and thus we see why bees, in times of severe cold, which they essay to keep at bay by forced respiration, consume much food, exhale much foul air and moisture, and are liable to disease. Newport found that in cases of severe cold there would be quite a rise of mercury in a thermometer which he suspended in the hive amidst the cluster. In the larva state, many insects breathe by fringe-like gills. The larval mosquito has gills in form of hairy tufts, while in the larval dragon-fly the gills are inside the rectum, or last part of the intestine. This insect, by a muscular effort, draws the water slowly in at the anus, when it bathes these singularly-placed branchiæ, and then makes it serve a further turn by forcibly expelling it, when the insect is sent darting ahead. Thus this curious apparatus not only furnishes oxygen, but also a mode of motion. In the pupæ of insects there is little or no motion, yet important organic changes are taking place—the worm-like, ignoble, creeping, often repulsive larva, is soon to appear as the airy, beautiful, active, almost ethereal imago. So oxygen, the most essential—the *sine qua non*—of all animal food, is still needed. The bees are too wise to seal the brood-cell with impervious wax, but rather adds the porous capping, made of wax and pollen. The pupæ no less than the larvæ of some two-wing flies, which live in water, have long tubes which reach far out for the

vivifying air, and are thus called rat-tailed. Even the pupæ of the mosquito, awaiting in its liquid home the glad time when it shall unfold its tiny wings and pipe its war-note, has a similar arrangement to secure the gaseous pabulum.

The digestive apparatus of insects is very interesting, and, as in our own class of animals, varies very much in length and complexity, as the hosts of insects vary in their habits. As in mammals and birds, the length, with some striking exceptions, varies with the food. Carnivorous or flesh-eating insects have a short alimentary canal, while in those that feed on vegetable food it is much longer.

FIG. 9.



Alimentary Canal.

o—Honey stomach. *b*—True stomach.
c—Urinary tubes. *d*—Intestine.

The mouth I have already described. Following this is the throat or pharynx, then the œsophagus or gullet, which may expand, as in the bee, to form a honey or sucking stomach (Fig. 9, *o*), may have an attached crop like the chicken, or may run as a uniform tube as in our bodies, to the true stomach (Fig. 9, *b*). Following this is the intestine—separated by some into an ileum and a rectum—which ends in a vent or anus. In the mouth are salivary glands, which in larvæ that form cocoons are the source of silk. In the glands this is a viscid fluid, but as it leaves the duct it changes instantly

into the gossamer thread. Bees and wasps use this saliva in building their structures. With it and mud some wasps make mortar; with it and wood, others their paper cells; with it and wax, the bee fashions the ribbons that are to form the beautiful comb.

Lining the entire alimentary canal are mucous glands which secrete a viscid fluid that keeps the tube soft, and promotes the passage of food.

The true stomach (Fig. 9, *b*) is very muscular, and often a gizzard, as in the crickets, where its interior is lined with teeth. The interior of the stomach is glandular, for secreting the gastric juice which is to liquify the food, that it may be absorbed, or pass through the walls of the canal into the blood. Attached to the lower portion of the stomach are numerous urinary tubes (Fig. 9, *c*), though Cuvier, and even Kirby, calls these bile tubes. Siebold thinks some of the mucous glands secrete bile, and others act as a pancreas.

The intestine when short, as in larvæ and most carnivores, is straight and but little if any longer than the abdomen, while in most plant-eaters it is long and thus zig-zag in its course. Strange as it may seem, the fecal pellets of some insects are beautiful in form, and of others pleasant to the taste. In some caterpillars they are barrel-shaped, artistically fluted, of brilliant hue, and, if fossilized, would be greatly admired, as have been the coprolites—fossil feces of quadrupeds—if set as gems in jewelry. As it is, they would form no mean parlor ornament. In other insects, as the Aphides or plant-lice, the excrement, as well as the fluid that escapes in some species from special tubes called the nectaries, is very sweet, and in absence of floral nectar, will often be appropropriated by bees and conveyed to the hives. Imagination would make this a bitter draught, so here as elsewhere in life, the bitter and sweet are mingled. In such insects as suck their food, as bees, butterflies, moths, two-wing flies and bugs, the feces are watery or liquid, while in case of solid food the excrement is solid.

SECRETORY ORGANS OF INSECTS.

I have already spoken of the salivary glands, which Kirby gives as distinct from the true silk-secreting tubes, though

Newport gives them as one and the same. In many insects these seem absent. I have also spoken of the mucous glands, the urinary tubules, etc. Besides these, there are other secretions which serve for purposes of defense: In the queen and workers of bees, and in ants and wasps, the poison intruded with the sting is an example. This is secreted by glands at the posterior of the abdomen, stored in sacks (Fig. 25, *c*), and extruded through the sting sheath as occasion requires. I know of no insect that poisons while it bites, except it be mosquitoes, gnats, etc., and in these cases no special secreting organ has been discovered. Perhaps the beak itself secretes an irritating substance. A few exceedingly beautiful caterpillars are covered with branching spines, which sting about like a nettle. We have two such species. They are green, and of rare attraction, so that to capture them is worth the slight inconvenience arising from their irritating punctures. Some insects, like bugs, secrete a disgusting fluid or gas which affords protection, as by its stench it renders these filthy bugs so offensive that even a hungry bird or half-famished insect passes them by on the other side. Some insects secrete a gas which is stored in a sack at the posterior end of the body, and shot forth with an explosion in case that danger threatens; thus by noise and smoke it startles its enemy, which beats a retreat. I have heard the little bombardier beetle at such times, even at considerable distances. The frightful reports about the terrible horn of the tomato-worm larva are mere nonsense. A more harmless animal does not exist. My little boy of four years, and girl of only two, used to bring them to me last summer, and fondle them as admiringly as would their father upon receiving them from the delighted children.

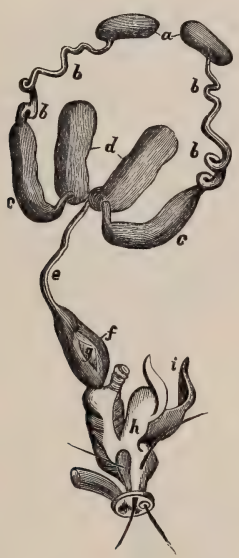
If we except bees and wasps, there are no true insects that need be feared; nor need we except them, for with fair usage even they, are seldom provoked to use their cruel weapon.

SEX ORGANS OF INSECTS.

The male organs consist first of the testes (Fig. 10, *a*) which are double organs. There may be from one, as in the drone bee, to several, as in some beetles, on each side the abdominal cavity. In these vesicles grow the sperm cells or

spermatozoa, which, when liberated, pass through a long convoluted tube; the vas-deferens (Fig. 10, *b*, *b*), into the seminal sack (Fig. 10, *c*, *c*), where, in connection with mucous, they are stored. In most insects there are glandular sacks (Fig. 10, *d*) joined to these seminal receptacles, which in the male bee or drone are very large. The sperm cells mingled with

FIG. 10.



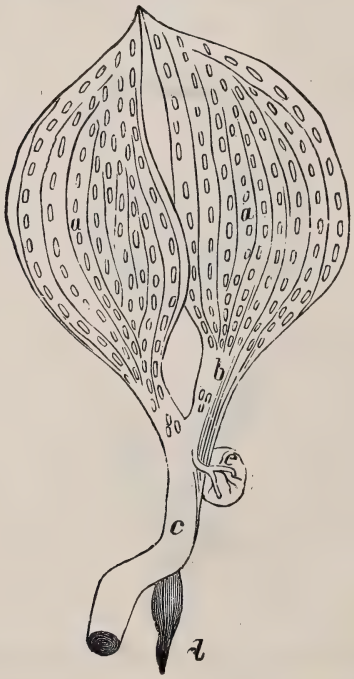
Male Organs of Drone, much magnified.

a—Testes.
b, *b*—Vasa deferentia.
c, *c*—Seminal sacks.
d—Glandular sacks.
e—Common duct.
f, *g*—Ejaculatory sack.
h—Penis.
i—Yellow saccules.

these viscid secretions, as they appear in the seminal receptacle, ready for use, form the seminal fluid. Extending from these seminal receptacles is the ejaculatory duct (Fig. 10, *e*, *f*, *g*), which in copulation carries the male fluid to the penis (Fig. 10, *h*), through which it passes to the spermatheca of the

female. Beside this latter organ is the sheath, the claspers when present, and in the male bee those large yellow sacks (Fig. 10, *i*), which are often seen to dart forth as the drone is held in the warm hand.

FIG. 11.



Queen Organs, greatly magnified.

a, *a*—Ovaries.
b—Oviducts.
c—Oviduct.
d—Sting.
e—Spermatheca.

The female organs (Fig. 11) consist of the ovaries (Fig. 11, *a*, *a*), which are situated one on either side of the abdominal cavity. From these extend the two oviducts, (Fig. 11, *b*),

which unite into the common oviduct (Fig. 11, *c*) through which the eggs pass in deposition. In many insects there is beside this oviduct, and connected with it, a sack (Fig. 11, *e*) called the spermatheca, which receives the male fluid in copulation, and which, by extruding its contents, must ever after do the work of impregnation.

This sack was discovered and its use suggested by Malpighi as early as 1686, but its function was not fully demonstrated till 1792, when the great anatomist, John Hunter, showed that in copulation this was filled. The ovaries are multitubular organs. In some insects there are but very few tubes—two or three ; while in the queen bee there are more than one hundred. In these tubes the ova or eggs *grow*, as do the sperm cells in the vesicles of the testes. The number of eggs are variable. Some insects, as the mud-wasps, produce very few, while the queen white-ant extrudes millions. The end of the oviduct, called the ovipositor, is wonderful in its variations. Sometimes it consists of concentric rings, like a spy-glass which may be pushed out or drawn in ; sometimes of a long tube armed with augers or saws of wonderful finish, to prepare for eggs ; or again of a tube which may also serve as a sting.

Most authors state that insects copulate only once, or at least that the female only meets the male but once. My pupil, Clement S. Strang, who made a special study of the structure and habits of bugs during the past season, noticed that the squash-bugs mated many times. It would be interesting to know whether these females possessed the spermatheca. In some cases, as we shall see in the sequal, the male is killed by the copulatory act. I think this curious fatality is limited to few species.

To study viscera, which of course requires very careful dissection, we need more apparatus than has been yet described. Here a good lens is indispensable. A small dissecting knife, a delicate pair of forceps, and some small, sharp-pointed dissecting scissors—those of the renowned Swammerdam were so fine at the point that it required a lens to sharpen them —which may also serve to clip the wings of queens—are requisite to satisfactory work. Specimens put in alcohol will be improved, as the oil will be dissolved out and the

muscle hardened. Placing them in hot water will do nearly as well, in which case oil of turpentine will dissolve off the fat. This may be applied with a camel's-hair brush. By dissecting under water the loose portions will float off, and render effective work more easy. Swammerdam, who had that most valuable requisite to a naturalist, unlimited patience, not only dissected out the parts, but with small glass tubes, fine as a hair, he injected the various tubes as the alimentary canal and air-tubes. My reader, why may not you look in upon those wondrous beauties and marvels of God's own handiwork—nature's grand exposition? Father, why would not a set of dissecting instruments be a most suitable gift to your son? You might thus sow the seed which would germinate into a Swammerdam, and that on your own hearth-stone. Messrs. Editors, why do not you, among your apiarian supplies, keep boxes of these instruments, and thus aid to light the torch of genius and hasten apiarian research?

TRANSFORMATIONS OF INSECTS.

What in all the realm of nature is so worthy to awaken delight and admiration as the astonishing changes which insects undergo? Just think of the sluggish, repulsive caterpillar, dragging its heavy form over clod or bush, or mining in dirt and filth, changed, by the wand of nature's great magician, first into the motionless chrysalis, decked with green and gold, and beautiful as the gem that glitters on the finger of beauty, then bursting forth as the graceful, gorgeous butterfly; which, by its brilliant tints and elegant poise, outrivals even the birds among the life-jewels of nature, and make it fit to revel in all her decorative wealth. The little fly, too, with wings dyed in rainbow-hues, flitting like a fairy from leaf to flower, was but yesterday the repulsive maggot, reveling in the veriest filth of decaying nature. The grub to-day drags its slimy shape through the slums of earth, on which it fattens; to-morrow it will glitter as the brilliant setting in the bracelets and ear-drops of the gay and thoughtless belle.

There are four separate stages in the development of insects: The egg state, the larva, the pupa, and the imago.

THE EGG.

This is not unlike the same in higher animals. It has its yolk and its surrounding white or albumen, like the eggs of all mammals, and farther, the delicate shell, which is familiar in the eggs of birds and reptiles. Eggs of insects are often beautiful in form and color, and not infrequently ribbed and fluted as by a master-hand. The form of eggs is very various —spherical, oval, cylindrical, oblong, straight and curved (Fig. 25, *b*). All insects seem to be guided by a wonderful knowledge, or instinct, or intelligence, in the placing of eggs on or near the peculiar food of the larva. Even though in many cases such food is no part of the aliment of the imago insect. The fly has the refined habits of the epicure, from whose cup it daintily sips, yet its eggs are placed in the horse-droppings of stable and pasture.

Inside the egg wonderful changes soon commence, and their consummation is a tiny larva. Somewhat similar changes can be easily and most profitably studied by breaking and examining a hen's egg each successive day of incubation. As with the egg of our own species and of all higher animals, so, too, the egg of insects, or the yolk, the essential part—the white is only food, so to speak—soon segments or divides into a great many cells, these soon unite into a membrane—the blastoderm—and this is the initial animal. This blastoderm soon forms a single sack, and not a double sack, one above the other, as in our own vertebrate branch. This sack, looking like a miniature bag of grain, grows, by absorption, becomes articulated, and by budding out is soon provided with the various members. As in higher animals, these changes are consequent upon heat, and usually, not always, upon the incorporations within the eggs of the germ cells from the male, which enter the eggs at openings called micropyles. The time it takes the embryo inside the egg to develop is gauged by heat, and will, therefore, vary with the season and temperature, though in different species it varies from days to months. The number of eggs, too, which an insect may produce, is subject to wide variation. Some insects produce but one, two or three, while others, like the queen bee and white ant, lay thousands, and in case of the ant, millions.

THE LARVA OF INSECTS.

From the egg comes the larva, also called grub, maggot, caterpillar, and very erroneously worm. These are worm-shaped (Fig. 12), usually have strong jaws, simple eyes, and the body plainly marked into ring divisions. Often as in case

FIG. 12.



Larva of Bee.

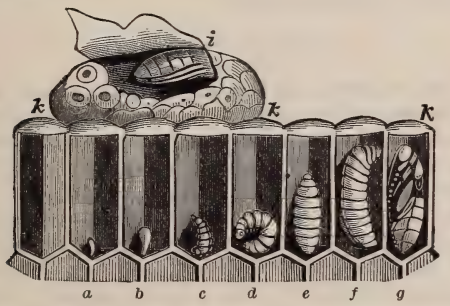
of some grubs, larval bees and maggots, there are no legs. In most grubs there are six legs, two to each of the three rings succeeding the head. Besides these, caterpillars have usually ten prop-legs farther back on the body, though a few—the loopers or measuring caterpillars—have only four or six, while the larvæ of the saw-flies have from twelve to sixteen of the false or prop-legs. The alimentary canal of larval insects is usually short, direct and quite simple, while the sex-organs are slightly if at all developed. The larvæ of insects are voracious eaters—indeed, their only work seems to be to eat and grow fat. As the entire growth occurs at this stage, their gormandizing habits are the more excusable. I have often been astonished at the amount of food that the insects in my breeding cases would consume. The length of time which insects remain as larvæ is very variable. The maggot revels in decaying meat but two or three days ; the larval bee eats its rich pabulum for nearly a week ; the apple-tree borer gnaws away for three years ; while the seventeen-year cicada remains a larva for more than sixteen years, groping in darkness, and feeding on roots, only to come forth for a few days of hilarity, sunshine, and courtship. Surely, here is patience exceeding even that of Swammerdam. The name larva, meaning masked, was given to this stage by Linnæus, as the mature form of the insect is hidden, and cannot be even divined by the unlearned.

THE PUPA OF INSECTS.

In this stage the insect is in profound repose, as if resting after its long meal, the better to enjoy its active, sportive

days—the joyous honey-moon—soon to come. In this stage the insect may look like a seed; as in the coarctate pupæ of diptera, so familiar in the "flax-seed" state of the Hessian-fly, or in the pupa of the cheese-maggot or the meat-fly. This same form, with more or less modification, prevails in butterfly pupæ, called, because of their golden spots, chrysalids, and in the pupæ of moths. Other pupæ, as in case of bees (Fig. 13, *g*) and beetles, look not unlike the mature insect with its

FIG. 13.



Pupa or Nymph of Bee, slightly magnified.

antennæ, legs, and wings closely bound to the body by a thin membrane, hence the name which Linné gave—referring to this condition—as the insect looks as if wrapped in swaddling clothes, the old cruel way of torturing the infant, as if it needed holding together. Aristotle called pupæ nymphs—a name now given to this stage in bees—which name was adopted by many entomologists of the seventeeth and eighteenth centuries. Inside the pupa skin great changes are in progress, for either by modifying the larval organs or developing parts entirely new, by use of the accumulated material stored by the larva during its prolonged banquet, the wonderful transformation from the sluggish, worm-like larva to the active, bird-like imago is accomplished. Sometimes the pupa is surrounded by a silken cocoon, either thick, as the cocoon of some moths, or thin, as are the cocoons of bees. These cocoons are spun by the larvæ as their last toil before assuming the restful pupa state. The length of time

in the pupa-stage is very various, lasting from a few days to as many months. Sometimes insects which are two-brooded remain as pupa but a few days in summer, while in winter they are months passing the quiescent period. Our cabbage-butterfly illustrates this peculiarity. Others, like the Hessian-fly and codling-moth, remain through the long, cold months as larvæ. How wonderful is this! The first brood of larvæ change to pupæ at once, the last brood, though the weather be just as hot, wait over inside the cocoon till the warm days of coming spring.

THE IMAGO STAGE.

This term refers to the last or winged form, and was given by Linné because the image of the insect is now real and not masked as when in the larva state. Now the insect has its full-formed legs and wings, its compound eyes, complex mouth-parts, and the fully developed sex-organs. In fact, the whole purpose of the insect now seems to be to reproduce itself. Many insects do not even eat, only flit in merry marriage mood for a brief space, when the male flees this life to be quickly followed by the female, she only waiting to place her eggs where the prospective infants may find suitable food. Some insects not only place their eggs, but feed and care for their young, as is true of ants, wasps and bees. Again, as in case of some species of ants and bees, abortive females perform all, or most of the labor in caring for the young. The life of the imago also varies much as to duration. Some live but for a day, others make merry for several days, while a few species live for months. Very few imago survive the whole year.

INCOMPLETE TRANSFORMATIONS.

Some insects, like the bugs, lice, grasshoppers and locusts, are quite alike at all stages of growth, after leaving the egg. The only apparent difference is the smaller size and the absence or incomplete development of the wings in the larvæ and pupæ. The habits and structure from first to last seem to be much the same. Here, as before, the full development of the sex-organs occurs only in the imago.

ANATOMY AND PHYSIOLOGY OF THE HONEY-BEE.

With a knowledge of the anatomy and some glimpses of the physiology of insects in general, we shall now find it easy to learn the special anatomy and physiology of the highest insects of the order.

THREE KINDS OF BEES IN EACH FAMILY.

As we have already seen, a very remarkable feature in the economy of the honey-bee, described even by Aristotle, which is true of many other bees, and also of ants and many wasps, is the presence in each family of three distinct kinds, which differ in form, color, structure, size, habits and function. Thus we have the queen, a number of drones, and a far greater number of workers. Huber, Bevan, Munn and Kirby also speak of a fourth kind blacker than the usual workers. These are accidental, and are, as conclusively shown by Von Berlepsch, ordinary workers, more deeply colored by loss of hair, dampness, or some other atmospheric condition. American apiarists are too familiar with these black bees, for after our severe winters they prevail in the colony, and, as remarked by the noted Baron, "*They quickly* disappear." Munn also tells of a fifth kind, with a top-knot, which appears at swarming seasons. I am at a great loss to know what he refers to, unless it be the pollen masses of the asclepias or milk-weed, which sometimes fasten to our bees and become a severe burden.

THE QUEEN BEE.

The queen (Fig. 14), although referred to as the mother bee, was called the king by Virgil, Pliny, and by writers as late as the last century, though in the ancient "Bee Master's Farewell," by John Hall, published in London in 1796, I find an admirable description of the queen bee, with her function correctly stated. Réaumur as quoted by "Wildman on Bees," published in London in 1770, says "this third sort has a grave and sedate walk, is armed with a sting, and is mother of all the others."

Huber, to whom every apiarist owes so much, and who, though blind, through the aid of his devoted wife and intel-

ligent servant, Frances Burnens, developed so many interesting facts, demonstrated the fact of the queen's maternity. This author's work, second edition, published in Edinburgh, in 1808,

FIG. 14.



Queen Bee, magnified.

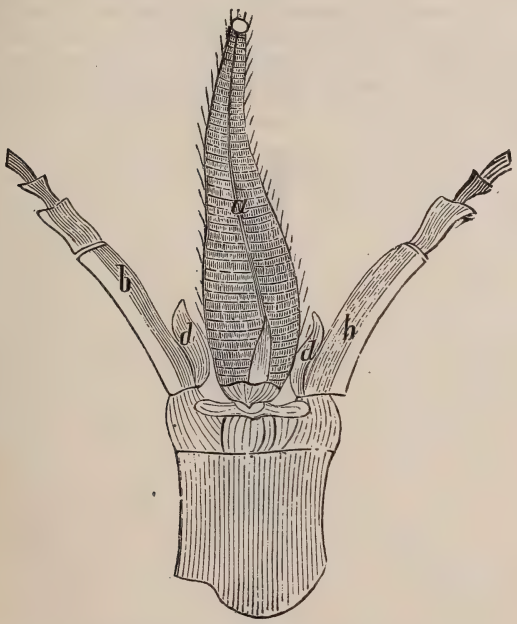
gives a full history of his wonderful observations and experiments, and must ever rank with Langstroth as a classic, worthy of study by all.

The queen, then, is the mother bee, in other words, a fully developed female. Her ovaries (Fig. 11, *a*, *a*) are very large, nearly filling her long abdomen. The tubes already described as composing them are very numerous, while the spermatheca (Fig. 11, *e*) is plainly visible. This is muscular, receives abundant nerves, and thus, without doubt, may or may not be compressed to force the sperm cells in contact with the eggs as they pass by the duct. Leuckart estimates that the spermatheca will hold more than 25,000,000 spermatozoa.

The possession of the ovaries and attendant organs, is the chief structural peculiarity which marks the queen, as these are the characteristic marks of females among all animals. But she has other peculiarities worthy of mention: She is longer than either drones or workers, being more than seven-eighths of an inch in length, and, with her long tapering abdomen, is not without real grace and beauty. The queen's mouth organs, too, are developed to a less degree than are those of the worker-bees. Her jaws (Fig. 21, *b*) or mandibles

are weaker, with a rudimentary tooth, and her tongue or ligula (Fig. 15, *a*), as also the labial palpi (Fig. 15, *b*) and maxillæ are considerably shorter. Her eyes, like the same in the worker-bee (Fig. 5), are smaller than those of the

FIG. 15.



Labium of Queen.

a—Ligula. *b*—Labial palpi.
d, *d*—Paraglossæ.

drones, and do not meet above. So the three ocelli are situated above and between. The queen's wings, too, (Fig. 14) are relatively shorter than those either of the workers or drones, for instead of attaining to the end of the body, they reach but little beyond the third joint of the abdomen. The queen, though she has the characteristic posterior tibia and basal tarsus (Fig. 16, *p*), in respect to breadth, has not the cavity and

surrounding hairs, which form the pollen baskets of the workers. The queen possesses a sting (Fig. 11, *d*) which is longer than that of the workers, and resembles that of the bumble-bees in being curved, and that of bumble-bees and wasps in having few and short barbs—the little projections which point back like the barb of a fish-hook, and which, in case of the workers, prevent the withdrawing of the instrument, when once fairly inserted. While there are seven quite prominent barbs on each shaft of the worker's sting, there are only three on those of the queen, and these are

FIG. 16.



Part of Leg of Queen, magnified.

t—Tibia. *p*—Broadened tibia and basal tarsus.
t s—Tarsal joints.

very short, and, as in a worker's sting, they are successively shorter as we recede from the point of the weapon. Aristotle says that the queen will seldom use her sting, which I have found true. I have often tried to provoke a queen's anger, but never with any evidence of success. Neighbour (page 14, note) gives three cases where queens used their stings, in one

of which cases she was disabled from farther egg-laying. She stings with slight effect.

The queen, like the neuters, is developed from an impregnated egg, which, of course, could only come from a queen that had previously mated. These eggs are not placed in a horizontal cell, but in one specially prepared for their reception (Fig. 26, *i*). These queen cells are usually built on the edge of the comb, or around an opening in it, which is necessitated from their size and form, as usually the combs are too close together to permit their location elsewhere. These cells extend either vertically or diagonally downward, are composed of wax mixed with pollen, and in size and form much resemble a pea-nut. The eggs must be placed in these cells, either by the queen or workers. Some apiarists think that the queen never places an egg in a queen cell, but I have no doubt of the fact, though I never witnessed the act. I have frequently seen eggs in these cells, and without exception in the exact position in which the queen always places her eggs in the other cells. John Hall, in the old work already referred to, whose descriptions, though penned so long ago, are wonderfully accurate, and indicate great care, candor, and conscientious truthfulness, asserts that the queen is five times as long laying a royal egg as she is the others. From the character of his work, and its early publication, I can but think that he had witnessed this rare sight. Some candid apiarists of our own time and country—E. Gallup among the rest—claim to have witnessed the act. The eggs are so well glued, and are so delicate, that, with Neighbour, I doubt the possibility of a removal. The opponents to this view base their belief on a supposed discord between the queen and neuters. This antagonism is inferred, and I have but little faith in the inference, or the argument from it. I know that when royal cells are to be torn down, and inchoate queens destroyed, the workers aid the queen in this destruction. I have also seen queens pass by unguarded queen-cells, and yet respect them. I have also seen several young queens dwelling amicably together in the same hive. Is it not probable that the bees are united in whatever is to be accomplished, and that when queens are to be destroyed all spring to the work, and when they are to live all regard them as sacred? It is true that

the actions of bees are controlled and influenced by the surrounding conditions or circumstances, but I have yet to see satisfactory proof of the old theory that these conditions impress differently the queen and the workers. The conditions which lead to the building of queen-cells and the peopling of the same are—loss of queen, when a worker larva from one to four days old will be surrounded by a cell; inability of a queen to lay impregnated eggs, her spermatheca having become emptied; great number of worker-bees in the hive; restricted quarters; the queen not having place to deposit eggs, or the workers little or no room to store honey; and lack of ventilation, so that the hive becomes too close. These last three conditions are most likely to occur at times of great honey secretion.

A queen may be developed from an egg, or from a worker larva less than three days old. Mr. Doolittle has known queens to be reared from worker larvæ taken at four-and-a-half days from hatching. In this latter case, the cells adjacent to the one containing the selected larva are removed, and the larva surrounded by a royal cell. The development of the queen larva is much like that of the worker, soon to be detailed, except that it is more rapid, and is fed richer and more plenteous food, called royal jelly. This peculiar food, as also its use and abundance in the cell, was first described by Schirach, a Saxon clergyman, who wrote a work on bees in 1771. According to Hunter, this royal pabulum is richer in nitrogen than that of the common larvæ. It is thick, like rich cream; slightly yellow, and so abundant that the queen larva not only floats in it during all its period of growth, but quite a large amount remains after her queenship vacates the cell. We often find this royal jelly in incomplete queen-cells, without larvæ. Mr. Quinby suggests that this is stored for future use.

What a mysterious circumstance is this: These royal scions simply receive a more abundant and sumptuous diet, and occupy a more ample habitation—for I have more than once confirmed the statement of Mr. Quinby, that the direction of the cell is immaterial—and yet what a marvelous transformation. Not only are the ovaries developed and filled with eggs, but the mouth-organs, the wings, the legs, and the sting, aye,

and the size, form and habits are all wondrously changed. That the development of parts should be accelerated, and the size increased is not so surprising—as in breeding other insects I have frequently found that kind and amount of food, would hasten or retard growth, and might even cause a dwarfed imago—but that it should so essentially modify the structure, is certainly a rare and unique circumstance, hardly to be found except here and in related animals. Bevan has suggested that fertile workers, while larvæ, have received some of this royal jelly, from their position near a developing queen. Langstroth supposes that they receive some royal jelly, purposely given by the workers, and I had previously thought this reasonable, and probably true. But these pests of the apiarist, and especially of the breeder, almost always, so far as I have observed, make their appearance in colonies long queenless, and I have noticed a case similar to that given by Quinby, where these occurred in a nucleus where no queen had been developed. May it not be true, that a desire for eggs stimulates growth of the ovaries, growth of eggs in the ovarian tubes, and consequent ability to deposit. The common high-holder, Colaptes auratus—a bird belonging to the woodpecker family, usually lays five eggs, and only five; but let cruel hands rob her of these promises of future loved ones—and wondrous to relate, she continues to lay more than a score. One thus treated, here on the College campus, actually laid more than thirty eggs. So we see that animal desires may influence and move organs that are generally independent of the will.

The larval queen is longer and more rapid of development than the other larvæ. When developed from the egg—as in case of normal swarming—the larva feeds for five days, when the cells are capped by the workers. The infant queen then spins her cocoon, which occupies about one day. The end of the cocoon is left open. Some one has suggested that this is an act of thoughtful generosity on the part of the queen larva, thus to render her own destruction more easy, should the welfare of the colony demand it, as now a sister queen may safely give the fatal sting. The queen now spends nearly three days in absolute repose. Such rest is common to all cocoon-spinning larvæ. The spinning, which is done by

a rapid motion to and fro of the head, always carrying the delicate thread, much like the moving shuttle of the weaver, seems to bring exhaustion and need of repose. She now assumes the nymph or pupa state (Fig. 26, *i*). At the end of the sixteenth day she comes forth a queen. Huber states that when a queen emerges, the bees are thrown into a joyous excitement, so that he noted a rise in the temperature of the hive from 92° F. to 104° F. I have never tested this matter accurately, but I have failed to notice any marked demonstration on the natal day of her lady-ship the queen, or extra respect paid her as a virgin. When queens are started from worker larvæ, they will issue as imago in ten or twelve days from the date of their new prospects. Mr. Doolittle writes me that he has known them to issue in eight and one-half days.

As the queen's development is probably due to superior quality and increased quantity of food, it would stand to reason that queens started from eggs are preferable ; the more so, as under normal circumstances, I believe, they are almost always thus started. The best experience sustains this position. As the proper food and temperature could best be secured in a full colony—and here again the natural economy of the hive adds to our argument—we should infer that the best queens would be reared in strong colonies, or at least kept in such colonies till the cells were capped. Experience also confirms this view. As the quantity and quality of food, and the general activity of the bees is directly connected with the full nourishment of the queen-larva, and as these are only at the maximum in times of active gathering—the time when queen-rearing is naturally started by the bees—we should also conclude that queens reared at such seasons are superior. My experience—and I have carefully observed in this connection—most emphatically sustains this view.

Five or six days after issuing from the cell—Neighbour says the third day—if the day is pleasant, the queen goes forth on her "marriage flight ;" otherwise she will improve the first pleasant day thereafter for this purpose. Huber was the first to prove that impregnation always takes place on the wing. Bonnet also proved that the same is true of ants, though in this case millions of queens and drones often swarm

out at once. I have myself witnessed several of these wholesale matrimonial excursions among ants. I have also frequently taken bumble-bees in copulo while on the wing. I have also noticed both ants and bumble-bees to fall while united, probably borne down by the expiring males. That butterflies, moths, dragon-flies, etc., mate on the wing is a matter of common observation. That it is possible to impregnate queens when confined, I think very doubtful. The queens will caress the drones, but the latter seem not to heed their advances. That this ever has been done I also question, though many think they have positive proof that it has occurred. Yet, as there are so many chances to be mistaken, and as experience and observation are so excessive against the possibility, I think that these may be cases of hasty or inaccurate judgment. Many, very many, with myself, have followed Huber in clipping the queen's wing, only to produce a sterile or drone-laying queen. Prof. Leuckart believes that successful mating demands that the large air-sacks (Fig. 2, *f*) of the drones shall be filled, which he thinks is only possible during flight. The demeanor of the drones leads me to think, that the excitement of flight, like the warmth of the hand, is necessary to induce the sexual impulse.

I presume, that in all the future, Huber's statement that the queen must take wing to be impregnated, will remain unrefuted. Yet it will do no harm to keep trying. Success *may come.* Mating, too, in green-houses or rooms is also impracticable. I have given this thorough trial. The drones are incorrigible cowards, and their inordinate fear seems even to overcome the sexual desires.

If the queen fails to find an admirer the first day, she will go forth again and again till she succeeds. Huber stated that after twenty-one days the case is hopeless. Bevan states that if impregnated from the fifteenth to the twenty-first she will be largely a drone-laying queen. That such absolute dates can be fixed in either of the above cases is very questionable. Yet, all experienced breeders know that queens kept through the winter as virgins are sure to remain so. It is quite likely that the long inactivity of the spermatheca wholly or in part paralyzes it, so that queens that are late in mating cannot impregnate the eggs as she desires. This

would accord with what we know of muscular organs. Berlepsch believed that a queen that commenced laying as a virgin could never lay impregnated eggs, even though she afterwards mated. Langstroth thought that he had observed to the contrary.

If the queen be observed after a successful "wedding tour," she will be seen to bear the marks of success in the pendant drone appendages, consisting of the penis, the yellow cul-de-sacks, and the hanging thread-like ducts.

It is not at all likely that a queen, after she has met a drone, ever leaves the hive again except that she leaves with a swarm. Some of the observing apiarists think that an old queen may be again impregnated. The fact that queens, with clipped wings, are as long fertile as others, makes me think that cases which have led to such conclusions are capable of other explanation.

If the queen lays eggs before meeting the drones, or if for any reason she fails to mate, her eggs will only produce male bees. This strange anomaly—development of the eggs without impregnation—was discovered and proved by Dzierzon, in 1845. Dr. Dzierzon, who, as a student of practical and scientific apiculture, must rank with the great Huber, is a Roman Catholic priest of Carlesmarkt, Germany. This doctrine—called parthenogenesis, which means produced from a virgin—is still doubted by some quite able bee-keepers, though the proofs are irrefragable: 1st. Unmated queens will lay eggs that will develop, but drones always result. 2d. Old queens often become drone-layers, but examination shows that the spermatheca is void of seminal fluid. Such an examination was first made by Prof. Siebold, the great German anatomist, in 1843, and later by Leuckart and Leidy. I have myself made several such examinations. The spermatheca can easily be seen by the unaided vision, and by crushing it on a glass slide, by compressing with a thin glass cover, the difference between the contained fluid in the virgin and impregnated queen is very patent, even with a low power. In the latter it is more viscid and yellow, and the vesicle more distended. By use of a high power, the active spermatozoa or germ-cells become visible. 3d. Eggs in drone-cells are found by the microscopist to be void of the sperm-cells, which

are always found in all other fresh-laid eggs. This most convincing, and interesting observation, was first made by Von Siebold, at the suggestion of Berlepsch. It is quite difficult to show this. Leuckart tried before Von Siebold, at Berlepsch's apiary, but failed. I have also tried to discover these germ-cells in worker-eggs, but as yet have been unsuccessful. Siebold has noted the same facts in eggs of wasps. 4th. Dr. Dönhoff, of Germany, in 1855, took an egg from a drone-cell, and by artificial impregnation produced a worker-bee. Such an operation, to be successful, must be performed as soon as the egg is laid.

Parthenogenesis, in the production of males, has also been found by Siebold to be true of other bees and wasps, and of some of the lower moths, in the production of both males and females. While the great Bonnet first discovered what may be noticed on any summer day, all about us, even on the house-plants at our very windows, that parthenogenesis is best illustrated by the aphides or plant lice. In the fall males and females appear, which mate, when the female lays eggs, which in the spring produce only females; these again produce only females, and thus on, for several generations, till with the cold of autumn come again the males and females. Bonnet observed seven successive generations of productive virgins. Duval noted nine generations in seven months, while Kyber observed production exclusively by parthenogenesis in a heated room for four years. So, we see, that this strange and almost incredible method of increase, is not rare in the great insect world.

About two days after she is impregnated, the queen, under normal circumstances, commences to lay, usually worker-eggs, and as the condition of the hive seldom impels to swarming the same summer, so that no drones are required, she usually lays no others the first season.

It is frequently noticed that the young queen at first lays quite a number of drone-eggs. Queen-breeders often observe this in their nuclei. This continues for only a few days. This does not seem strange. The act of forcing the sperm-cells from the spermatheca is muscular and voluntary, and that these muscles should not always act promptly at first, is not strange, nor is it unprecedented. Mr. Wagner suggested that

the size of the cell determined the sex, as in the small cells the pressure on the abdomen forced the fluid from the spermatheca. Mr. Quinby also favored this view. I greatly question this theory. All observing apiarists have known eggs to be laid in worker-cells, ere the cell was hardly commenced, when there could be no pressure. In case of queen-cells, too, if the queen does lay the eggs—as I believe—these would be unimpregnated, as the cell is very large. I know the queen sometimes passes from drone to worker-cells very abruptly while laying, as I have witnessed such a procedure—the same that so greatly rejoiced the late Baron of Berlepsch, after weary hours of watching—but that she can thus control at the instant this process of adding or withholding the sperm-cells, certainly seems not so strange as that the spermatheca, hardly bigger than a pin-head, could supply these cells for months, yes, and for years. Who that has seen the bot-fly dart against the horse's legs, and as surely leave the tiny yellow egg, can doubt but that insects possess very sensitive oviducts, and can extrude the minute eggs *just* at pleasure. That a queen may force single eggs, at will, past the mouth of the spermatheca, and at the same time add or withhold the sperm-cells, is, I think, without question, true. What gives added force to this view, is the fact that other bees, wasps and ants exercise the same volition, and can have no aid from cell-pressure, as all the eggs are laid in receptacles of the same size. But the Baron of Berlepsch, worthy to be a friend of Dzierzon, has fully decided the matter. He has shown that old drone cells are as small as new worker-cells, and yet each harbors its own brood. Very small queens, too, make no mistakes. With no drone-cells, the queen will sometimes lay drone-eggs in worker-cells, in which drones will then be reared. And will, if she must, though with great reluctance, lay worker-eggs in drone-cells.

Before laying an egg, the queen takes a look into the cell, probably to see if all is right. If the cell contains any honey, pollen, or an egg, she usually passes it by, though when crowded, a queen will sometimes, *especially if young*, insert two or three eggs in a cell, and sometimes, in such cases, she drops them, when the bees show their dislike of waste, and appreciation of good living, by making a breakfast

of them. If the queen finds the cell to her liking, she turns about, inserts her abdomen, and in an instant the tiny egg is glued, in position (Fig. 26, *b*) to the bottom of the cell.

The queen, when considered in relation to the other bees of the colony, possesses a surprising longevity. It is not surprising for her to attain the age of three years in the full possession of her powers, while they have been known to do good work for five years. Queens, often at the expiration of one, two, three or four years, depending on their vigor and excellence, either cease to be fertile, or else become impotent to lay impregnated eggs—the spermatheca having become emptied of its sperm-cells. In such cases the workers usually supersede the queen; that is they destroy the old queen, ere all the worker-eggs are gone, and take of the few remaining ones to start queen-cells, and thus rear young, fertile and vigorous queens.

It sometimes happens, though rarely, that a fine-looking queen, with full-formed ovaries, and large spermatheca, well-filled with male-fluid, will deposit freely, but none of the eggs will hatch. Readers of the bee-publications know that I have freqently received such for dissection. The first I ever got was a remarkably fine-looking Italian, received from the late Dr. Hamlin, of Tennessee. All such queens that I have examined seem perfect, even though scrutinized with a high-power objective. We can only say that the egg is at fault, as frequently transpires with higher animals, even to the highest. These females are barren; through some fault with the ovaries, the eggs grown therein are sterile. To detect just what is the trouble with the egg is a very difficult problem, if it is capable of solution at all. I have tried to determine the ultimate cause, but without success.

The function of the queen is simply to lay eggs, and thus keep the colony populous; and this she does with an energy that is fairly startling. A good queen in her best estate will lay two or three thousand eggs a day. I have seen a queen in my observing hive, lay for some time at the rate of four eggs per minute, and have proved by actual computation of brood cells, that a queen may lay over three thousand eggs in a day. Langstroth and Berlepsch both saw queens lay at the rate of six eggs a minute.

The latter had a queen that laid three thousand and twenty-one eggs in 24 hours, by actual count, and in 20 days she laid fifty-seven thousand. This queen continued prolific for five years, and must have laid, says the Baron, at a low estimate, more than 1,300,000 eggs. Dzierzon says queens may lay 1,000,000 eggs, and I think these authors have not exaggerated. Yet, with even these figures as an advertisement, the queen bee cannot boast of superlative fecundity, as the queen white-ant—an insect closely related to the bees in habits, though not in structure, as the white-ants are lace-wings and belong to the sub-order Neuroptera, which includes our day-flies, dragon-flies, etc.—is known to lay over 80,000 eggs daily. Yet this poor helpless thing, whose abdomen is the size of a man's thumb, and composed almost wholly of eggs, while the rest of her body is not larger than the same in our common ants, has no other amusement; she cannot walk; she cannot even feed herself or care for her eggs. What wonder then that she should attempt big things in the way of egg-laying? She has nothing else to do, or to feel proud of.

Different queens vary as much in fecundity as do different breeds of fowls. Some queens are so prolific that they fairly demand hives of India rubber to accommodate them, keeping their hives gushing with bees and profitable activity; while others are so inferior, that the colonies make a poor, sickly effort to survive at all, and usually succumb early, before those adverse circumstances which are ever waiting to confront all life on the globe. The activity of the queen, too, is governed largely by the activity of the workers. The queen will either lay sparingly, or stop altogether, in the interims of storing honey, while, on the other hand, she is stimulated to lay to her utmost capacity, when all is life and activity in the hive.

It would seem that the queen either reasons from conditions, is taught by instinct, or else that without her volition the general activity of the worker-bees stimulates the ovaries, how, we know not, to grow more eggs. We know that such a stimulus is born of desire, in case of the high-holder, already referred to. That the queen may have control of the activity of her ovaries, either directly or indirectly, through reflex

nervous action induced by the general excitement of the bees, which always follows active storing, is not only possible, but quite likely.

The old poetical notion that the queen is the revered and admired sovereign of the colony, whose pathway is ever lined by obsequious courtiers, whose person is ever the recipient of loving caresses, and whose will is law in this bee-hive kingdom, controlling all the activities inside the hive, and leading the colony whithersoever they may go, is unquestionably mere fiction. In the hive, as in the world, individuals are valued for what they are worth. The queen, as the most important individual, is regarded with solicitude, and her removal or loss noted with consternation, as the welfare of the colony is threatened; yet, let the queen become useless, and she is despatched with the same absence of emotion that characterizes the destruction of the drones when they have become supernumeraries. It is very doubtful if emotion or sentimentality are ever moving forces among the lower animals. There are probably certain natural principles that govern in the economy of the hive, and aught that conspires against, or tends to intercept the action of these principles, becomes an enemy to the bees. All are interested, and doubtless more united than is generally believed, in a desire to promote the free action of these principles. No doubt the principle of antagonism among the various bees has been overrated. Even, the drones, when they are being killed off in the autumn, make a sickly show of defense, as much as to say, the welfare of the colony demands that such worthless vagrants should be exterminated; "so mote it be;" go ahead. The statement, too, that there is often serious antagonism between the queen and workers, as to the destruction or preservation of inchoate queens, yet in the cell, is a matter which may well be investigated. It is most probable that what tends most for the prosperity of the colony is well understood by all, and without doubt there is harmonious action among all the denizens of the hive, to foster that which will advance the general welfare, or to make war on whatever may tend to interfere with it. If the course of any of the bees seems wavering and inconsistent, we may rest assured that circumstances have changed, and that could we perceive the bearing of all the

surrounding conditions, all would appear consistent and harmonious.

THE DRONES.

These are the male bees, and are generally found in the hive only from May to November; though they may remain all winter, and are not infrequently absent during the summer. Their presence or absence depends on the present and prospective condition of the colony. If they are needed, or likely to be needed, then they are present. There are in

FIG. 17.



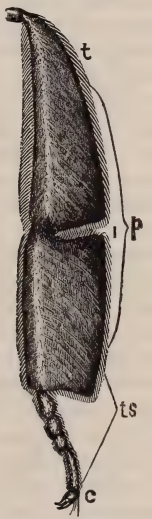
Drone Bee, magnified.

nature several hundred in each colony. The number may and should be greatly reduced by the apiarist. These (Fig. 17) are shorter than the queen, being less than three-fourths of an inch in length, are more robust and bulky than either the queen or workers, and are easily recognized when flying by their loud, startling hum. As in other societies, the least useful make the most noise. This loud hum is caused by the less rapid vibration of their large, heavy wings. Their flight is more heavy and lumbering than that of the workers. Their ligula, labial palpi, and maxillæ—like the same in the queen bee—are short, while their jaws (Fig. 21, *a*) possess the rudimentary tooth, and are much the same in form as those of the queen, but are heavier, though not so strong as those of the workers. Their eyes (Fig. 4) are very prominent, meet above, and thus the simple eyes are thrown forward. Their posterior legs are convex on the outside (Fig. 18), so, like the queens, they have no pollen baskets. The drones are without

the defensive organ, having no sting, while their special sex-organs (Fig. 10) are not unlike those of other insects, and have already been sufficiently described.

It was discovered by Dzierzon, in 1845, that the drones hatch from unimpregnated eggs. This strange phenomenon, seemingly so incredible, is as has been shown in speaking of

FIG. 18.



Part of Leg of Drone, magnified.

t—Tibia.
p—Broadened tibia and basal tarsus.
t s—Joints of Tarsus.
c—Claws.

the queen, easily proved and beyond question. These eggs may come from an unimpregnated queen, a fertile worker—which will soon be further described—or from an impregnated queen, which may voluntarily prevent impregnation. Such eggs may be placed in the larger horizontal cells (Fig. 28, *a*), in manner already described. As stated by Bevan, the drone feeds six and a half days as a larva, before the cell is capped. The capping of the drone-cells is very convex, and projects beyond the plane of the same in worker-cells, so that the

drone brood is easily distinguished from worker, and from the darker color—the wax being thicker and less pure—the capping of both drone and worker brood-cells enable us easily to distinguish them from honey-cells. In twenty-four days from the laying of the egg, the drones come forth from the cells. Of course variation of temperature, and other conditions, as variable amount of diet, may slightly retard or advance the development of any brood, in the different stages. The drones—in fact all bees—when they first emerge from the cells, are gray, soft, and appear generally unsophisticated.

Just what the longevity of the male bee is, I am unable to state. It is probable, judging from analogy, that they live till accident, the worker bees, or the performance of their natural function causes their death. The worker-bees are liable to kill off the drones, which they do by constantly biting and worrying them. They may also destroy the drone-brood. It is not very rare to see workers carrying out immature drones even in mid-summer. At the same time, too, they may destroy inchoate queens. Such action is prompted by a sudden check in the yield of honey, and with the drones is most common at the close of the season. The bees seem very cautious and far-sighted. If the signs of the times presage a famine, they stay all proceedings looking to the increase of colonies. On the other hand, unlimited honey, rapid increase of brood, crowded quarters—whatever the age of the queen—is sure to bring many of the male bees. While any circumstances that indicate a future need of drones will prevent their destruction even in late autumn.

The function of the drones is solely to impregnate the queen, though when present they may add animal heat. That their nutrition is active, is suggested by the fact, that upon dissection, we always find their capacious stomachs filled with honey.

Impregnation of the queen always takes place, as before stated, while on the wing, outside the hive, usually during the heat of warm sunshiny days. After mating, the drone organs adhere to the queen, and may be seen hanging to her for some hours. The copulatory act is fatal to the drones. By holding a drone in the hand, the ejection of the sex-organs is often produced, and always followed by immediate death. As the

queen only meets a single drone, and that only once, it might be asked why nature was so improvident as to decree hundreds of drones to an apiary or colony, whereas a score would suffice as well. Nature takes cognizance of the importance of the queen, and as she goes forth amidst the myriad dangers of the outer world, it is safest and best that her stay abroad be not protracted; that the experience be not repeated, and especially, that her meeting a drone be *not delayed*. Hence the superabundance of drones—especially under natural conditions, isolated in forest homes, where ravenous birds are ever on the alert for insect game—is most wise and provident. Nature is never "penny wise and pound foolish." In our apiaries the need is wanting, and the condition, as it exists in nature, is not enforced.

The fact that parthenogenesis prevails in the production of the drones, has led to the theory that from a pure queen, however mated, must ever come a pure drone. My own experience and observation, which I believe are those of all apiarists, has confirmed this theory. Yet, if the impure mating of our cows, horses, and fowls, renders the females of mixed blood ever afterward, as is believed and taught by many who would seem most competent to judge—though I must say I am somewhat skeptical in the matter—then we must look closely as to our bees, for certainly, if a mammal, and especially a fowl, is tainted by impure mating, then we may expect the same of insects. In fowls such influence, if it exists, must come simply from the presence in the female generative organs of the germ-cells, or spermatozoa, and in mammals, too, there is little more than this, for though they are viviporous, so that the union and contact of the offspring and mother seems very intimate, during fœtal development, yet there is no intermingling of the blood, for a membrane ever separates that of the mother from that of the fœtus, and only the nutritious or waste elements pass from one to the other. To claim that the mother is tainted through the circulation, is like claiming that the same result would follow her inhaling the breath of her progeny after birth. I can only say, that I believe this whole matter is still involved in doubt, and still needs more careful, scientific and prolonged observation.

THE NEUTERS, OR WORKER-BEES.

These, called "the bees," by Aristotle, and even by Wildman and Bevan, are by far the most numerous individuals of the hive—there being from 1,500 to 4,000 in every good colony. It is possible for a colony to be even much more

FIG. 19.



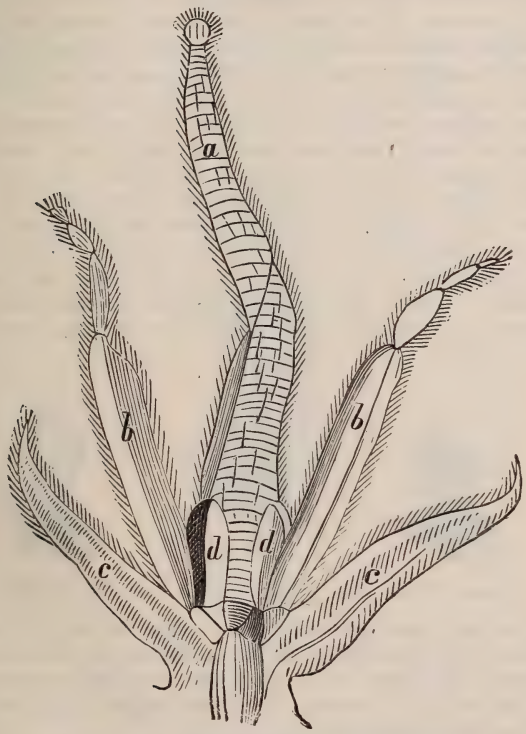
Worker-Bee, magnified.

populous than this. These are also the smallest bees of the colony, as they measure but little more than one-half of an inch in length (Fig. 19).

The workers—as taught by Schirach, and proved by Mlle. Jurine, of Geneva, Switzerland, who, at the request of Huber, sought for and found, by aid of her microscope, the abortive ovaries—are undeveloped females. Rarely, and probably very rarely, except that a colony is long or often queenless, as is frequently true of our nuclei, these bees are so far developed as to produce eggs, which, of course, would always be drone eggs. Such workers—known as fertile—were first noticed by Riem, while Huber actually saw one in the act of egg-laying. Except in the power to produce eggs, they seem not unlike the other workers. Huber supposed that these were reared in cells contiguous to royal cells, and thus received royal food by accident. The fact, as stated by Mr. Quinby, that these occur in colonies where queen-larvæ were never reared, is fatal to the above theory. Langstroth and Berlepsch thought that these bees, while larvæ, were fed, though too sparingly, with the royal aliment, by bees in need of a queen, and hence the accelerated development. Such may be the true explanation. Yet, if as some apiarists aver, these appear where no brood has been fed, and so must be common workers, changed after leaving the cell, as the result of a felt need,

then we must conclude that development and growth—as with the high-holder—springs from desire. The generative organs are very sensitive, and exceedingly susceptible to impressions,

FIG. 20.



Tongue of a Worker-Bee, much magnified.

a—Ligula.
b, b—Labial palpi.
c, c—Maxillæ.
d—Paraglossæ.

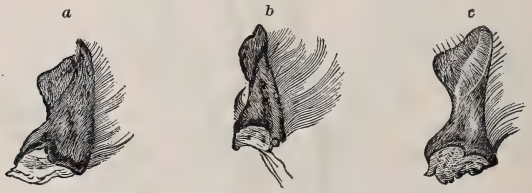
[The average length of a black worker's tongue, as compared with this from an Italian, would be from base to *a*.]

and we may yet have much to learn as to the delicate forces which will move them to growth and activity. Though these fertile workers are a poor substitute for a queen, as they are

incapable of producing any but drones, and are surely the harbingers of death and extinction to the colony, yet they seem to satisfy the workers, for they will not brook the presence of a queen when a fertile worker is in the hive, nor will they suffer the existence in the hive of a queen-cell, even though capped. They seem to be satisfied, though they have very slight reason to be so. These fertile workers lay indifferently in large or small cells—often place several eggs in a single cell, and show their incapacity in various ways.

The workers, as might be surmised by the importance and variety of their functions, are structurally very peculiar: Their tongues (Fig. 20, *a*), labial palpi (Fig. 20, *b*, *b*), and maxillæ (Fig. 20, *c*, *c*), are very much elongated, while the former is very hairy, and doubles under the throat when not in use. The length of the ligula enables them to reach into flowers with long tubes, and by aid of the hairs they lap up the nectar. When the tongue is big with its adhering load of sweet, it is doubled back, enclosed by the labial palpi and

FIG. 21.



a—Jaw of drone. *b*—Jaw of queen *c*—Jaw of worker.

maxillæ, and then extended, thus losing its load of nectar, which at the same time is sucked into the large honey-stomach. The bees, at will, can force the honey back from the honey-stomach, when it is stored in the honey-cells or given to the other bees.

The jaws (Fig. 21, *c*) are very strong, without the rudimentary tooth, while the cutting edge is semi-conical, so that when the jaws are closed they form an imperfect cone. Thus these are well formed to cut comb, knead wax, and perform their various functions. Their eyes (Fig. 5) are like those of the queen, while their wings, like those of the drones, attain

the end of the body. These organs (Fig. 3), as in all insects with rapid flight, are slim and strong, and, by their more or less rapid vibrations, give the variety of tone which characterizes their hum. Thus we have the rapid movements and high pitch of anger, and the slow motion and mellow note of content and joy.

On the outside of the posterior tibia and basal tarsus is a cavity, made more deep by its rim of hairs, known as the pollen

FIG. 22.



Part of Posterior Leg of Worker, outside, much magnified.

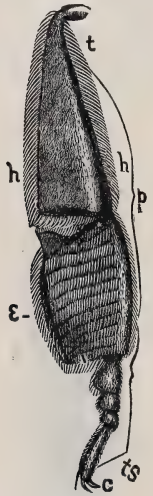
t—Tibia.
h—Rim of hairs.
p—Pollen basket.
t s—Joint of tarsi.
c—Claws.

basket (Fig. 22, *p*). In these pollen baskets is compacted the pollen, which is gathered by the mouth organs, and carried back by the four anterior legs. Opposite the pollen baskets are regular rows of golden hairs (Fig. 23, *e*), which probably aid in storing and compacting the pollen balls.

On the anterior legs of the workers, between the femur and tibia, is a curious notch (Fig. 24, *C*), covered by a spur (Fig. 24,

B). For several years this has caused speculation among my students, and has attracted the attention of observing apiarists. Some have supposed that it aided bees in reaching deeper down into tubular flowers, others that it was used in scraping

FIG. 23.



Part of Worker's Posterior Leg, inside, much magnified.

e—Rows of hairs. *t*—Tibia. *c*—Claws.

off pollen, and still others that it enabled bees to hold on when clustering. The first two functions may belong to this,

FIG. 24

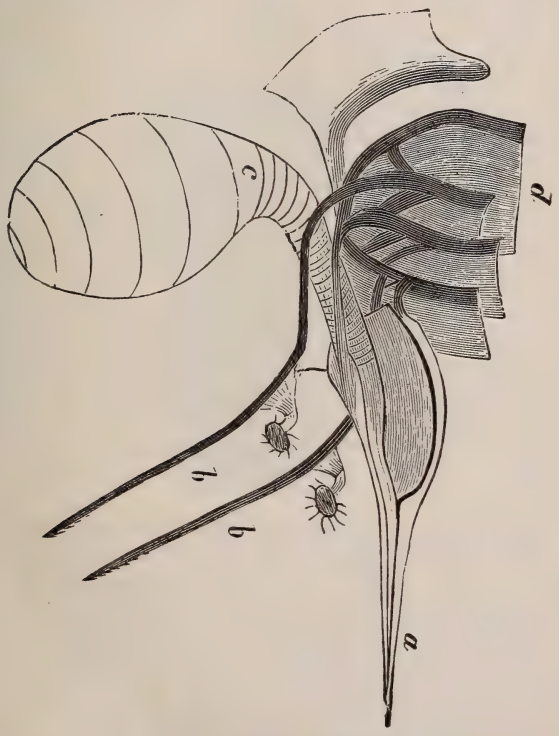


Anterior Leg of Worker, magnified.

though other honey and pollen-gathering bees do not possess it. The latter function is performed by the claws at the end of the tarsi.

The workers, too, possess an organ of defense (Fig. 25), which they are quick to use if occasion requires. This is not curved as in the queen, but straight. The gland

FIG. 25.



Worker's Sting, magnified.

a—Tube.
bb—Barbed spears drawn out of tube and turned back,
c—Poison sack.
d—Muscles.

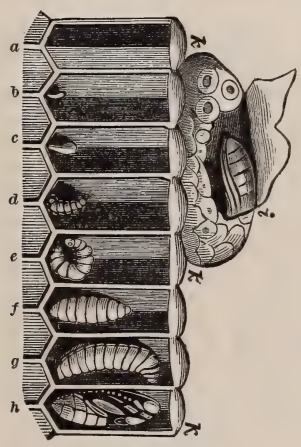
which secretes the poison is double, and the sack (Fig. 25, *c*), in which it is stored, is as large as a flax-seed. The sting proper, is a triple organ, consisting of three sharp spears, very smooth and of exquisite polish. The most highly-wrought

steel instruments, under a high magnifier, look rough and unfinished, while the parts of the sting show no such inequalities. One of these spears (Fig. 25, *a*) is canaliculate—that is, it forms an imperfect tube—and in this canal work the other two (Fig. 25, *b*, *b*), which fill the vacant space, and thus the three make a complete tube, and through this tube, which connects with the poison sack, passes the poison. The slender spears which work in the tube are marvelously sharp, and project beyond it when used, and are worked alternately by small but powerful muscles (Fig. 25, *d*), so they may pass through buckskin, or even the thick scarf-skin of the hand. These are also barbed at the end with teeth, seven of which are prominent, which extend out and back like the barb of a fish-hook. Hence the sting cannot be withdrawn, if it penetrates any firm substance, and so when used, it is drawn from the bee, and carries with it a portion of the alimentary canal, thus costing the poor bee its life. Darwin suggests that bees and wasps were developed from the saw-flies, and that the barbs on the sting are the old-time saws, transformed into the spear-like barbs. He does not explain why these are so much shorter and more obscure in the queen, and in other bees and wasps. The honey-stomach or crop in the workers (Fig. 9, *o*) is well developed, though no larger than those in the drones. Whether it is more complex in structure, I do not know.

The workers hatch from an impregnated egg, which can only come from a queen that has met a drone, and is always laid in the small, horizontal cell. These eggs are in no wise different, so far as we can see, from those which are laid in the drone or queen-cells. All are cylindrical and slightly curved (Fig. 26, *b*, *c*) and are fastened by one end to the bottom of the cell, and a little to one side of the centre. As already shown, these are voluntarily fertilized by the queen as she extrudes them, preparatory to fastening them in the cells. These eggs, though so small—one-sixteenth of an inch long—may be easily seen by holding the comb so that the light will shine into the cells. With experience, they are detected almost at once, but I have often found it quite difficult to make the novice see them, though very plainly visible to my experienced eye.

The egg hatches in three days. The larva (Fig. 26, *d*, *e*, *f*, *g*), incorrectly called grub, maggot—and even caterpillar, by Hunter—is white, footless, and lies coiled up in the cell till near maturity. It is fed a whitish fluid, though this seems to be given grudgingly, as it never seems to have more than it

FIG. 26.



Egg and Brood.

b and c—Eggs.
d, *e*, *f* and *g*—Various sizes of larvæ.
h—Pupa.
i—Pupa of queen, in queen-cell.
k, *k*—Caps.

wishes to eat, so it is fed quite frequently by the mature workers. It would seem that the workers fear an excessive development, which, as we have seen, is most mischievous and ruinous, and work to prevent the same, by a mean and meager diet. The food is composed of pollen and honey. Certainly of pollen, for, as I have repeatedly proved, without pollen, no brood will be reared. Probably some honey is incorporated, as sugar is an essential in the nutrition of all animals, and we could hardly account for the excessive amount of honey consumed, while breeding, by the extra amount consumed by the bees, consequent upon the added exercise required in

caring for the brood. M. Quinby, Doolittle, and others, say water is also an element of this food. But bees often breed very rapidly when they do not leave the hive at all, and so water, other than that contained in the honey, etc., cannot be added. This makes it a question if water is ever added. The time when bees seem to need water, and so repair to the rill and the pond, is during the heat of summer, when they are most busy. May this not be quaffed to slake their own thirst?

In six days the cell is capped over by the worker-bees. This cap is composed of pollen and wax, so it is darker, more porous, and more easily broken than the caps of the honey-cells; it is also more convex (Fig. 26, *k*). The larva, now full grown, having lapped up all the food placed before it, surrounds itself with a silken cocoon, so excessively thin that it requires a great number to appreciably reduce the size of the cells. These always remain in the cell, after the bees escape, and give to old comb its dark color and great strength. Yet they are so thin, that cells used even for a dozen years, seem to serve as well for brood as when first used. In three days the insect assumes the pupa state ((Fig. 26, *h*). In all insects the spinning of the cocoon seems an exhaustive process, for so far as I have observed, and that is quite at length, this act is succeeded by a variable period of repose. The pupa is also called a nymph. By cutting open cells it is easy to determine just the date of forming the cocoon, and of changing to the pupa state. The pupa looks like the mature bee with all its appendages bound close about it, though the color is still whitish.

In twenty-one days the bee emerges from the cell. The old writers were quite mistaken in thinking that the advent of these was an occasion of joy and excitement among the bees. All apiarists have noticed how utterly unmoved the bees are, as they push over and crowd by these new-comers in the most heedless and discourteous manner imaginable. Wildman tells of seeing the workers gathering pollen and honey the same day that they came forth from the cells. This idea is quickly disproved if we Italianize black-bees. We know that for some days these young bees do not leave the hive at all, except in case of swarming, when bees even too young to fly

will essay to go with the crowd. These young bees, like the young drones and queens, are much lighter for the first few days.

The worker-bees never attain a great age. Those reared in autumn may live for eight or nine months, and if in queenless stocks, where little labor is performed, even longer; while those reared in spring will wear out in three, and when most busy, will often die in from thirty to forty-five days. None of these bees survive the year through, so there is a limit to the number which may exist in a colony. As a good queen will lay, when in her best estate, three thousand eggs daily, and as the workers live from one to three months, it might seem that four thousand was too small a figure for the number of workers. Without doubt a greater number is possible. That it is rare is not surprising, when we remember the numerous accidents and vicissitudes that must ever attend the individuals of these populous communities.

The function of the worker-bees is to do all the manual labor of the hives. They secrete the wax, which forms in small pellets (Fig. 27, *a*, *a*) under the over-lapping rings under the abdomen. I have found these wax-scales on both old and young. According to Fritz Müller, the admirable German observer, so long a traveler in South America, the bees of the genus melipona secrete the wax on the back.

The young bees build the comb, ventilate the hive, feed the larvæ and cap the cells. The older bees—for, as readily seen in Italianizing, the young bees do not go forth for the first one or two weeks—gather the honey, collect the pollen, or bee-bread, as it is generally called, bring in the propolis or bee glue, which is used to close openings, and as a cement, supply the hive with water (?), defend the hive from all improper intrusion, destroy drones when their day of grace is past, kill and arrange for replacing worthless queens, destroy inchoate queens, drones, or even workers, if circumstances demand it, and lead forth a portion of the bees when the conditions impel them to swarm.

When there are no young bees, the old bees will act as housekeepers and nurses, which they otherwise refuse to do. The young bees, on the other hand, will not go forth to glean, even though there be no old bees to do this necessary part of

bee-duties. An indirect function of all the bees is to supply animal heat, as the very life of the bees require that the temperature inside the hive be maintained at a rate considerably above freezing. In the chemical processes attendant upon nutrition, much heat is generated, which, as first shown by Newport, may be considerably augmented at the pleasure of the bees, by forced respiration. The bees, too, by a rapid vibration of their wings, have the power to ventilate their hives, and thus reduce the temperature, when the weather is hot. Thus they moderate the heat of summer, and temper the cold of winter.



Under Surface of Bee, showing Wax between Segments.

CHAPTER III.

SWARMING OR NATURAL METHOD OF INCREASE.

The natural method by which an increase of colonies among bees is secured, is of great interest, and though it has been closely observed, and assiduously studied for a long period, and has given rise to theories as often absurd as sound, yet, even now, it is a fertile field for investigation, and will repay any who may come with the true spirit of inquiry, for there is much concerning it which is involved in mystery. Why do bees swarm at unseemly times? Why is the swarming spirit so excessive at times and so restrained at other seasons? These and other questions we are too apt to refer to erratic tendencies of the bees, when there is no question but that they follow naturally upon certain conditions, perhaps intricate and obscure, which it is the province of the investigator to discover. Who shall be first to unfold the principles which govern these, as all other actions of the bees?

In the spring or early summer, when the hive has become populous, and storing very active, the queen, as if conscious that a home could be overcrowded, and foreseeing such danger, commences to deposit drone-eggs in drone-cells, which the worker-bees, perhaps moved by like considerations, begin to construct, if they are not already in existence. In fact, drone comb is almost sure of construction at such times. No sooner is the drone brood well under way, than the large, awkward, queen-cells are commenced, often to the number of ten or fifteen, though there may be not more than three or four. In these, eggs are placed, and the rich royal jelly added, and soon, often before the cells are even capped—and *very rarely* before a cell is built, if the bees are crowded, the hives unshaded, the ventilation insufficient, or the honey-yield very bountiful—some bright day, usually about ten o'clock, after an unusual disquiet both inside and outside the hive, a

large part of the worker-bees—being off duty for the day, and having previously loaded their honey-sacks—rush forth from the hive as if alarmed by the cry of fire, the queen among the number, though she is by no means among the first, and frequently is quite late in her exit. The bees, thus started on their quest for a new home, after many uproarious gyrations about the old one, dart forth to alight upon some bush, limb, or fence, though in one case I have known the first swarm of bees to leave at once, for parts unknown, without even waiting to cluster. After thus meditating for the space of from one to three hours, upon a future course, they again take wing and leave for their new home, which they have probably already sought out.

Some suppose the bees look up a home before leaving the hive, while others claim that scouts are in search of one while the bees are clustered. The fact that bees take a right-line to their new home, and fly too rapidly to look as they go, would argue that a home is preêmpted, at least, before the cluster is dissolved. The fact that the cluster remains sometimes for hours—even over night—and at other times for a brief period, would lead us to infer that the bees cluster, in waiting for a new home to be found. Yet, why do bees sometimes alight after flying a long distance, as did a first swarm the past season, upon our College grounds? Was their journey long, so that they must needs stop to rest, or were they flying at random, not knowing whither they were going?

If for any reason the queen should fail to join the bees, and perhaps rarely, when she is among them, they will, after having clustered, return to their old home. The youngest bees will remain in the old hive, to which those bees, if there are any such, which are abroad in quest of stores will return. The presence of young bees on the ground—those with flight too feeble to join the rovers—will always mark the previous home of the emigrants. Soon, in seven or eight days, perhaps rarely a little later, the first queen will come forth from her cell, and in two or three days she will or may lead a new colony forth, but before she does this, the peculiar note, known as the piping of the queen, may be heard. This piping sounds like peep, peep, is shrill and clear, and can be plainly heard by placing the ear to the hive, nor would it be

mistaken. It is followed by a lower, hoarser note, made by a queen still within the cell.

Some have supposed that the cry of the liberated queen was that of hate, while that by the queen still imprisoned was either of enmity or fear. Never will an after-swarm leave, unless preceded by this peculiar note.

At successive periods of one or two days, one, two, or even three more colonies may issue from the old home. These last swarms will all be heralded by the piping of the queen. They will be less particular as to the time of day when they issue, as they have been known to leave before sun-rise, and even after sun-set. The well-known apiarist, Mr. A. F. Moon, once knew a swarm to issue by moon-light. They will, too, as a rule, cluster farther from the hive. The after swarms are preceded by the queen, and in case swarming is delayed, may be attended by a plurality of queens. Berlepsch and Langstroth both saw eight queens issue with a swarm, while others report even more. These virgin queens fly very rapidly, so the swarm will seem more active and definite in their course than will first swarms.

The cutting short of swarming preparations before the second, third, or even the first swarm issues, is by no means a rare occurrence. This is effected by the bees' destroying the queen-cells, and sometimes by a general extermination of the drones, and is generally to be explained by a cessation of the honey yield. Cells thus destroyed are easily recognized, as they are torn open from the side, and not cut back from the end.

Swarming out at other times, especially in late winter and spring, is sometimes noticed by apiarists. This is due to famine, mice, or some other disturbing circumstance, which makes the hive intolerable to the bees.

CHAPTER IV.

PRODUCTS OF BEES; THEIR ORIGIN AND FUNCTION.

Among all insects, bees stand first in the variety of the useful products which they give us; and next to the silk-moths in the importance of these products. They seem the more remarkable and important, in that so few insects yield articles of commercial value. True, the cochineal insect, a species of bark-louse, gives us an important coloring material; the lac insect, of the same family, gives us the important element of our best glue—shellac; the blister-beetles afford an article prized by the physician, while we are indebted to one of the gall-flies for a valuable element of ink. But the honey-bee affords not only a delicious article of food, but also another article of no mean commercial rank —namely, wax. We will proceed to examine the various products which come from bees.

HONEY.

Of course the first product of bees, not only to attract attention, but also in importance, is honey. And what is honey? We can only say that it is a sweet substance gathered from flowers and other sources, by the bees. We cannot, therefore, give its chemical composition, which would be as varied as the sources from which it comes. We cannot even call it a sugar, for it may be, and always is composed of various sugars, and thus it is easy to understand why honey varies so much in richness, color, flavor, and effects on digestion. In fact, it is very doubtful if honey is a manufactured article at all. It seems most likely that the bees only collect it as it is distilled by myriad leaves and flowers, and store it up, that it may minister to their and our necessities. To be sure, some writers contend that it undergoes some change while in the bee's stomach; but the rapidity with which they

store, and the seeming entire similarity between honey and sugar fed to them, and the same immediately extracted from the comb, has led me to believe that the transforming power of the stomach is very slight, if, indeed, it exists at all. To be sure, I have fed sugar, giving bees empty combs at night-fall, and found the flavor of honey early the next morning. In this case, honey might have been already in the bees' stomachs, or might have been carried from other portions of the hive. The method of collecting the honey has already been described. The principles of lapping and suction are both involved in the operation.

When the stomach is full, the bee repairs to the hive, and regurgitates its precious load, either giving it to the bees or storing it in the cells. Mr. Doolittle claims that the bees that gather, give all their honey to the other bees, which latter store it in the cells. This honey remains for some time uncapped that it may ripen, by which process the water is partially evaporated, and the honey rendered thicker. If the honey remains uncapped, or is removed from the cells, it will generally granulate, if the temperature be reduced below 70°. This is probably owing to the presence of the cane-sugar, and is a good indication, as it denotes superior quality. Some honey, as that from the South, and some from California, seems to remain liquid indefinitely. Some kinds of our own honey crystallize much more readily than others. But that granulation is a test that honey is pure, is untrue ; that it is a sign of superior excellence, I think quite probable.

When there are no flowers, or when the flowers yield no sweets, the bees, ever desirous to add to their stores, frequently essay to rob other colonies, and often visit the refuse of cider mills, or suck up the oozing sweets of various plant or bark lice, thus adding, may be, unwholesome food to their usually delicious and refined stores. It is a curious fact that the queen never lays her maximum number of eggs except when storing is going on. In fact, in the interims of honey-gathering, egg-laying not infrequently ceases altogether. The queen seems discreet, gauging the size of her family by the probable means of support.

Again, in times of extraordinary yields of honey, the storing

is so rapid that the hive becomes so filled that the queen is unable to lay her full quota of eggs; in fact, I have seen the brood very much reduced in this way, which, of course, greatly depleted the colony. This might be called ruinous prosperity.

The natural use of the honey is to furnish the mature bees with food, and when mixed with pollen, to form the diet of the young bees.

WAX.

The product of the bees, second in importance, is wax. This is a solid, unctious substance, and is, as shown by its chemical composition, a fat-like material, though not as some authors assert, the fat of bees. As already observed, this is a secretion formed in pellets, the shape of an irregular pentagon

FIG. 27.



Under-side Abdomen, magnified.
a, a, etc.—Wax pellets.



Wax-Scales in situ, magnified.
w—Wax-scale.

(Fig. 27, *w*), underneath the abdomen. These pellets are light-colored, very thin and fragile, and are secreted by and molded upon the membrane towards the body from the wax-pockets. Neighbour speaks of the wax oozing through pores from the stomach. This is not the case, but, as with the synovial fluid about our own joints, is formed by the secreting membrane, and does not pass through holes, as water through a sieve. There are four of these wax-pockets on each side, and thus there may be eight wax-scales on a bee at one time. This wax can be secreted by the bees, when fed on pure sugar, as shown by Huber, which experiment I have verified. I removed all honey and comb from my observing-hive, left the bees for twenty-four hours to digest all food which might be

in their stomachs, then fed pure sugar, which was better than honey, as Prof. R. F. Kedzie has shown by analysis that not only filtered honey, but even the nectar which he collected right from the flowers themselves, contains nitrogen. The bees commenced at once to build comb, and continued for several days, so long as I kept them confined. This is, as we should suppose ; sugar contains hydrogen and oxygen in proportion to form water, while the third element, carbon, is in the same or about the same proportion as the oxygen. Now, the fats usually contain little oxygen, and a good deal of carbon and hydrogen. Thus, the sugar by losing some of its oxygen would contain the requisite elements for fat. It was found true in the days of slavery in the South, that the negroes of Louisiana, during the gathering of the cane, would become very fat. They ate much sugar ; they gained much fat. Now, wax is a fat-like substance, not that it is the animal fat of bees, as often asserted—in fact it contains much less hydrogen, as will be seen by the following formula from Hess :

Oxygen	7.50
Carbon	79.30
Hydrogen	13.20

—but it is a special secretion for a special purpose, and from its composition, we should conclude that it might be secreted from a purely saccharine diet, and experiment confirms the conclusion. It has been found that bees require about twenty pounds of honey to secrete one of wax.

That nitrogenous food is necessary, as claimed by Langstroth and Neighbour, is not true. Yet, in the active season, when muscular exertion is great, nitrogenous food must be imperatively necessary to supply the waste, and give tone to the body. Some may be desirable even in the quiet of winter. Now, as secretion of wax demands a healthy condition of the bee, it indirectly requires some nitrogenous food.

It is asserted, that to secrete wax, bees need to hang in compact clusters or festoons, in absolute repose. Such quiet would certainly seem conducive to most active secretion. The same food could not go to form wax, and at the same time supply the waste of tissue which ever follows upon muscular activity. The cow, put to hard toil, could not give so much milk. But I find, upon examination, that the bees, even the most aged, while gathering in the honey season, yield up the

wax-scales, the same as those within the hive. During the active storing of the past season, especially when comb-building was in rapid progress, I found that nearly every bee taken from the flowers contained the wax-scales of varying sizes in the wax-pockets. By the activity of the bees, these are not infrequently loosed from their position, and fall to the bottom of the hive.

It is probable that wax secretion is not forced upon the bees, but only takes place as required. So the bees, unless wax is demanded, may perform other duties. Whether this secretion is a matter of the bee's will, or whether it is excited by the surrounding conditions without any thought, are questions yet to be settled.

These wax-scales are loosened by the claws, and carried to the mouth by the anterior legs, where they are mixed with saliva, and after the proper kneading by the jaws, in which process it assumes a bright yellow hue—but loses none of its translucency—it is formed into that wonderful and exquisite structure, the comb.

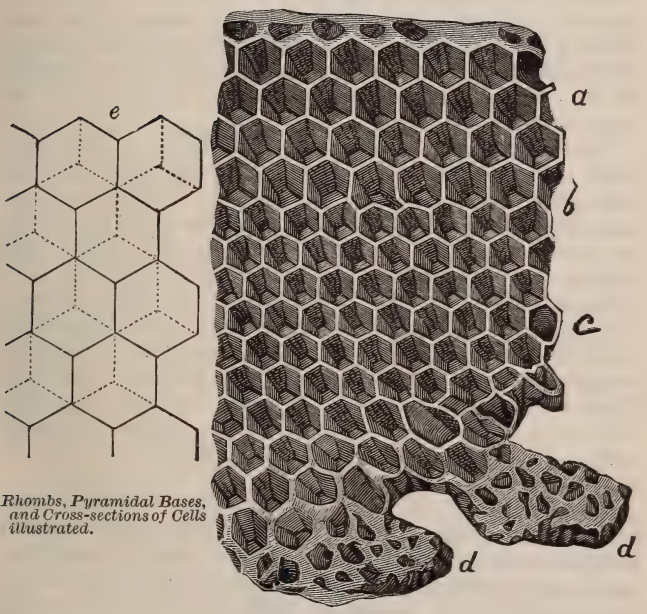
Honey-comb is wonderfully delicate, the wall of a new cell being only about 1-180 of an inch in thickness, and so formed as to combine the greatest strength with the least expense of material and room. It has been a subject of admiration since the earliest time. That the form is a matter of necessity, as some claim—the result of pressure—and not of bee-skill, is not true. The hexagonal form is assumed at the very start of the cells, when there can be no pressure. The wasp builds the same form, though unaided. The assertion that the cells, even the drone and worker-cells, are absolutely uniform and perfect, is also untrue, as a little inspection will convince any one. The late Prof. Wyman proved that an exact hexagonal cell does not exist. He showed that the size varies; so that in a distance of ten worker-cells, there may be a variation of one diameter. And this in natural, not distorted cells. This variation of one-fifth of an inch in ten cells is extreme, but a variation of one-tenth of an inch is common. The sides, as also the angles, are not constant. The rhombic faces forming the bases of the cells also vary.

The bees change from worker (Fig. 28, *c*) to drone-cells (Fig. 28, *a*), which are one-fifth larger, and *vice versa*, not

by any system (Fig. 28, *b*), but simply by enlarging or contracting. It usually takes about four rows to complete the transformation, though the number of deformed cells vary from two to eight.

The structure of each cell is quite complex, yet full of interest. The base is a triangular pyramid (Fig. 28, *e*) whose

FIG. 28.



Rhombs, Pyramidal Bases, and Cross-sections of Cells illustrated.

Honey-Comb.

a—Drone-cells.
b—Deformed cells.
c—Worker-cells.
d d—Queen-cells.

three faces are rhombs, and whose apex forms the very centre of the floor of the cell. From the six free or non-adjacent edges of the three rhombs extend the lateral walls or faces of the cell. The apex of this basal pyramid is a point where the contiguous faces of three cells on the opposite side meet, and form the angles of the bases of three cells on the oppo-

site side of the comb. Thus, the base of each cell forms one-third of the base of each of three opposite cells. One side thus braces the other, and adds much to the strength of the comb. Each cell, then, is in form of a hexagonal prism, terminating in a flattened triangular pyramid.

The bees usually build several combs at once, and carry forward several cells on each side of each comb, constantly adding to the number, by additions to the edge. Huber first observed the process of comb-building, noticing the bees abstract the wax-scales, carry them to the mouth, add the frothy saliva, and then knead and draw out the yellow ribbons which were fastened to the top of the hive, or added to the comb already commenced.

The diameter of the worker-cells (Fig. 28, *c*) averages little more than one-fifth of an inch—Réaumur says two and three-fifths lines or twelfths of an inch. While the drone-cells (Fig. 28, *a*) are a little more than one-fourth of an inch, or, according to Réaumur, three and one-third lines. But this distinguished author was quite wrong when he said: "These are the invariable dimensions of all cells that ever were or ever will be made." The depth of the worker-cells is a little less than half an inch; the drone-cells are slightly extended so as to be a little more than half an inch deep. These cells are often drawn out so as to be an inch long, when used solely as honey receptacles. The capping of the brood-cells is dark, porous, and convex, while that of the honey is white and concave.

The character of the cells, as to size, that is whether they are drone or worker, seems to be determined by the relative abundance of bees and honey. If the bees are abundant and honey needed, or if there is no queen to lay eggs, drone-comb (Fig. 28, *a*) is invariably built, while if there are few bees, and of course little honey needed, then worker-comb (Fig. 28, *c*) is almost as invariably formed.

All comb when first formed is clear and transparent. The fact that it is often dark and opaque implies that it has been long used as brood-comb, and the opacity is due to the innumerable thin cocoons which line the cells. These may be separated by dissolving the wax; which may be done by putting it in boiling alcohol. Such comb need not be dis-

carded, for if composed of worker-cells, it is still very valuable for breeding purposes, and should not be destroyed till the cells are too small for longer service, which will not occur till after many years of use.

The function, then, of the wax, is to make comb, and caps for the honey-cells, and, combined with pollen, to form queen-cells (Fig. 28, *d*) and caps for the brood cells.

POLLEN, OR BEE-BREAD.

An ancient Greek author states that in Hymettus the bees tied little pebbles to their legs to hold them down. This fanciful conjecture probably arose from seeing the pollen balls on the bees' legs.

Even such scientists as Réaumur, Bonnet, Swammerdam, and many apiarists of the last century, thought they saw in these pollen-balls the source of wax. But Huber, John Hunter, Duchet, Wildman, and others, noticed the presence and function of the wax-pellets already described, and were aware that the pollen served a different purpose.

This substance, like honey, is not secreted, nor manufactured by the bees, only collected. The bees usually obtain it from the stamens of flowers. But if they gain access to flour when there is no bloom, they will take this in lieu of pollen, in which case the former term used above becomes a misnomer, though usually the bee-bread consists almost wholly of pollen.

As already intimated, the pollen is conveyed in the pollen-baskets (Fig. 22, *p*) of the posterior legs, to which it is conveyed by the other legs, and compressed into little oval masses. The motions in this conveyance are exceedingly rapid. The bees not infrequently come to the hives, not only with replete pollen-baskets, but with their whole under surface thoroughly dusted. Dissection will also show that the same bee may have her sucking stomach distended with honey. Thus the bees make the most of their opportunities. It is a curious fact, noticed even by Aristotle, that the bees, during any trip, gather only a single kind of pollen, or only gather from one species of bloom. Hence, while different bees may have different colors of pollen, the pellets of bee-bread on any single bee will be uniform in color throughout. It is

possible that the material is more easily collected and compacted when homogeneous.

The pollen is usually deposited in the small or worker cells, and is unloaded by a scraping motion of the posterior legs, the pollen baskets being first lowered into the cells. The bee thus freed, leaves the wheat-like masses thus deposited to be packed by other bees. The cells, which may or may not have the same color of pollen throughout, are never filled quite to the top, and not infrequently the same cell may contain both pollen and honey. Such a condition is easily ascertained by holding the comb between the eye and the sun. If there is no pollen it will be wholly translucent; otherwise there will be opaque patches. A little experience will make this determination easy, even if the comb is old. It is often stated that queenless colonies gather no pollen, but this is not true, though very likely they gather less than they otherwise would. It is probable that pollen, at least when honey is added, contains all the essential elements of animal food. It certainly contains the very important principle, which is not found in honey—nitrogenous material.

The function of bee-bread is to help furnish the brood with proper food. In fact, brood-rearing would be impossible without it. And though it is certainly not essential to the nourishment of the bees when in repose, it still may be so, and unquestionably is, in time of active labor.

PROPOLIS.

This substance, also called bee-glue, is collected as the bees collect pollen, and not made nor secreted. It is the product of various resinous buds, and may be seen to glisten on the opening buds of the hickory and horse-chestnut, where it frequently serves the entomologist by capturing small insects. From such sources, from the oozing gum of various trees, from varnished furniture, and from old propolis about unused hives, that have previously seen service, do the bees secure their glue. Probably the gathering of bees about coffins to collect their glue from the varnish, led to the custom of rapping on the hives to inform the bees, in case of a death in the family, that they might join as mourners. This custom still prevails, as I understand, in some parts of the South.

This substance has great adhesive force, and though soft and pliable when warm, becomes very hard and unyielding when cold.

The use of this substance is to cement the combs to their supports, to fill up all rough places inside the hive, to seal up all crevices except the place of exit, which they often contract, and even to cover any foreign substance that cannot be removed. Intruding snails have thus been imprisoned inside the hive. Réaumur found a snail thus encased; Maraldi, a slug similarly entombed; while I have myself observed a bombus, which had been stripped by the bees of wings, hair, etc., in their vain attempts at removal, also encased in this unique style of a sarcophagus, fashioned by the bees.

BIBLIOGRAPHY.

For those who wish to pursue these interesting subjects more at length, I would recommend the following authors as specially desirable: Kirby and Spence, Introduction to Entomology; Duncan's Transformations of Insects; Packard's Guide to the Study of Insects (American); F. Huber's New Observations on the Natural History of Bees; Bevan on the Honey Bee; Langstroth on the Honey Bee (American); Neighbour on The Apiary.

I have often been asked to recommend such treatises, and I heartily commend all of the above. The first and fourth are now out of print, but can be had by leaving orders at second-hand book-stores.

PART SECOND.



THE APIARY;

Its Care and Management.



Motto:—"Keep all Colonies Strong!"

INTRODUCTION TO PART II.

STARTING AN APIARY.

In apiculture, as in all other pursuits, it is all-important to make a good beginning. This demands preparation on the part of the apiarist, procuring of bees, and location of his apiary.

PREPARATION.

Before starting in the business, the prospective bee-keeper should inform himself in the art.

READ A GOOD MANUAL.

To do this, he should procure some good manual, and thoroughly study, especially the practical part of the business; and if accustomed to read, think and study, should carefully read the whole work. Otherwise, he will avoid confusion by only studying the methods of practice, leaving the principles and science, to strengthen, and be strengthened by, his experience. Unless a student, he had better not take a journal till he begins the actual work, as so much unclassified information, without any experience to correct, arrange, and select, will but mystify. For the same reason, he may well be content with reading a single work, till experience, and a thorough study of this one, makes him more able to discriminate; and the same reasoning will preclude his taking more than one bee-periodical, until he has had at least a year's actual experience.

VISIT SOME APIARIST.

In this work of self-preparation, he will find great aid in visiting the nearest successful and intelligent apiarist. If successful, such an one will have a reputation; if intelligent, he will take the journals, and will show by his conversation that he knows of the methods and views of his brother apiarists, and above all, he will not think *he knows it all*, and that his is the only way to success. Learn all you can

of such an one, but always let your own judgment and common sense sit as umpire, that you make no plans or decisions that your judgment does not fully sustain.

TAKE A COLLEGE COURSE.

It will be *most wise* to take a course in some College, if this is practicable, where apiculture is thoroughly discussed. Here you will not only get the best training as to your chosen business, as you will study, see and handle, and thus will have the very best aids to decide as to methods, system and apparatus, but will also receive that general culture, which will greatly enhance life's pleasures and usefulness, and which ever proves the best capital in any vocation.

DECIDE ON A PLAN.

After such a course as suggested above, it will be easy to decide as to location, hives, style of honey to raise, and general system of management. But here, as in all the arts, all our work should be preceded by a well-digested plan of operations. As with the farmer and gardener, only he who works to a plan can hope for the best success. Of course, such plans will vary as we grow in wisdom and experience. A good maxim to govern all plans is, "go slow." A good rule, which will insure the above, "Pay as you go." Make the apiary pay for all improvements in advance. Demand that each year's credits exceed its debits ; and that you may surely accomplish this, keep an accurate account of all your receipts and expenses. This will be a great aid in arranging the plans for each successive year's operations.

Above all, avoid hobbies, and be slow to adopt sweeping changes. "Prove all things, and hold fast that which is good."

HOW TO PROCURE OUR FIRST COLONIES.

To procure colonies from which to form an apiary, it is always best to get them near at hand. We thus avoid the shock of transportation, can see the bees before we purchase, and in case there is any seeming mistake, can easily gain a personal explanation, and secure a speedy adjustment of any real wrong.

KIND OF BEES TO PURCHASE.

At the same price always take Italians, as undoutedly they are best. If black bees can be secured for three, or even for two dollars less per colony, by all means take them, as they can be Italianized at a profit for the difference in cost, and, in the operation, the young apiarist will gain valuable experience.

Our motto, too, will demand that we only purchase strong colonies. If, as recommended, the purchaser sees the colonies before the bargain is closed, it will be easy to know that the colonies are strong. If the bees, as they come rushing out, remind you of Vesuvius at her best, or bring to mind the gush and rush at the nozzle of the fireman's hose, then buy. In the hives of such colonies, all combs will be covered with bees, and in the honey season, brood will be abundant.

IN WHAT KIND OF HIVES.

As plans are already made, of course it is settled as to the style of hive to be used. Now, if bees can be procured in such hives, they will be worth just as much more than though in any other hive, as it costs to make the hive and transfer the bees. This will be certainly as much as three dollars. *No apiarist will tolerate, unless for experiment, two styles of hives in his apiary.* Therefore, unless you find bees in such hives as you are to use, it will be best to buy them in box hives and transfer (see Chapter VII.) to your own hives, as such bees can always be bought at reduced rates. In case the person from whom you purchase will take the hives back at a fair rate, after you have transferred the bees to your own hives, then purchase in any style of movable comb hive, as it is easier to transfer from a movable comb hive, than from a box hive.

WHEN TO PURCHASE.

It is safe to purchase any time in the summer. In April or May—of course you only purchase strong stocks—if in the latitude of New York or Chicago—it will be earlier further south—you can afford to pay more, as you will secure the increase both of honey and bees. If you desire to purchase in autumn, that you may gain by the experience of

wintering, either demand that the one of whom you purchase insure the safe wintering of the bees, or else that he reduce the selling price, at least one-third, from his rates the next April. Otherwise the novice had better wait and purchase in spring. If you are to transfer at once, it is almost imperative that you buy in spring, as it is vexatious, especially for the novice, to transfer when the hives are crowded with brood and honey.

HOW MUCH TO PAY.

Of course the market, which will ever be governed by supply and demand, must guide you. But to aid you, I will append what at present would be a reasonable schedule of prices almost anywhere in the United States: For box hives, crowded with black bees—Italians would rarely be found in such hives—five dollars per colony is a fair price. For black bees in hives such as you desire to use, eight dollars would be reasonable. For pure Italians in such hives, ten dollars is not too much.

If the person of whom you purchase, will take back the movable hives after you transfer the bees, you can afford to pay five dollars for black bees, and seven dollars for pure Italians. If you purchase in the fall, require $33\frac{1}{3}$ per cent. discount on these rates.

WHERE TO LOCATE.

If apiculture is an avocation, then your location will be fixed by your principal business or profession. And here I may state, that if we may judge from reports which come from nearly every section of the United States, from Maine to Texas, and from Florida to Oregon, you can hardly go amiss anywhere in our goodly land.

If you are to engage as a specialist, then you can select first with reference to society and climate, after which it will be well to secure a succession of natural honey-plants (Chap. XVI.), by virtue of your locality. It will also be well to look for reasonable prospects of a good home market, as good home markets are, and must ever be, the most desirable. It will be desirable, too, that your neighborhood is not overstocked with bees. It is a well-established fact, that apiarists with few colonies receive relatively larger profits than those with large

apiaries. While this may be owing in part to better care, much doubtless depends on the fact that there is not an undue proportion of bees to the number of honey-plants, and consequent secretion of nectar. To have the undisputed monopoly of an area reaching at least four miles in every direction from your apiary, is unquestionably a great advantage.

If you desire to begin two kinds of business, so that your dangers from possible misfortune may be lessened, then a small farm—especially a fruit farm—in some locality where fruit-raising is successfully practiced, will be very desirable. You thus add others of the luxuries of life to the products of your business, and at the same time may create additional pasturage for your bees by simply attending to your other business. In this case, your location becomes a more complex matter, and will demand still greater thought and attention. Some of Michigan's most successful apiarists are also noted as successful pomologists.

For position and arrangement of apiary see Chapter VI.

CHAPTER V.

HIVES AND BOXES

An early choice among the innumerable hives is of course demanded; and here let me state with emphasis, *that none of the standard hives are now covered by patents, so let no one buy rights.* Success by the skillful apiarist with almost any hive is possible. Yet, without question, some hives are far superior to others, and for certain uses, and with certain persons, some hives are far preferable to others, though all may be meritorious. As a change in hives, after one is once engaged in apiculture, involves much time, labor and expense, this becomes an important question, and one worthy earnest consideration by the prospective apiarist. I shall give it a first place, and a thorough consideration, in this discussion of practical apiculture.

BOX-HIVES.

I feel free to say that no person who reads, thinks, and studies—and success in apiculture can be promised to no other—will ever be content to use the old box-hives. In fact, thought and intelligence, which imply an eagerness to investigate, are essential elements in the apiarist's character. And, to such an one a box-hive would be valued just in proportion to the amount of kindling-wood it contained. A very serious fault with one of our principal bee-books, which otherwise is mainly excellent in subject matter and treatment, is the fact that it presumes its readers to be box-hive men. As well make emperors, kings, and chivalry the basis of good government, in an essay written for American readers. I shall entirely ignore box-hives in the following discussions, for I believe no sensible, intelligent apiarists, such as read books, will tolerate them, and that supposing they would, it would be an expensive mistake, which I have no right to encourage, in fact, am bound to discourage, not only for the benefit of individuals, but also for the art itself.

To be sure of success, the apiarist must be able to inspect the whole interior of the hive at his pleasure, must be able to exchange combs from one hive to another, to regulate the movements of the bees : by destroying queen-cells, by giving or withholding drone-comb, by extracting the honey, by introducing queens, and by many other manipulations to be explained, which are only practicable with a movable-frame hive.

MOVABLE-COMB HIVES.

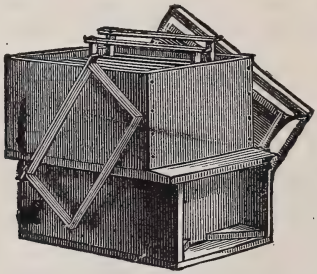
There are, at present, two types of the movable-comb hive in use among us, each of which is unquestionably valuable, as each has advocates among our most intelligent, successful and extensive apiarists. Each, too, has been superseded by the other, to the satisfaction of the person making the change. The kind most used consists of a box, in which hang the frames which hold the combs. The adjacent frames are so far separated that the combs, which just fill them, shall be the proper distance apart. In the other kind, the frames are wider than the comb, and when in position are close together, and of themselves form two sides of a box. When in use, these frames are surrounded by a second box, without a bottom, which, with them, rests on a bottom board. Each of these kinds is represented by various forms, sizes, etc., where the details are varied to suit the apiarist's notion. Yet, I believe that all hives in present use, worthy of recommendation, fall within one or the other of the above named types.

THE LANGSTROTH HIVE.

This (Fig. 29) is the hive most in use among Americans and Britons, if not among all who practice improved apiculture. It is stated that the late Major Munn was first to invent this style of hive. He states, (see Bevan, p. 37) that he first used it in 1834. But, as suggested by Neighbour, in his valuable hand-book, the invention was of no avail to apiarists, as it was either unknown, or else ignored by practical men. This invention also originated independently with Rev. L. L. Langstroth, who brought it forth in 1851, so perfect, that it needed scarce any improvement ; and for this gift, as well as his able researches in apiculture, as given in his invaluable

book, "The Honey-Bee," he has conferred a benefit upon our art which cannot be over-estimated, and for which we, as apiarists, cannot be too grateful. It was his book—one of my old teachers, for which I have no word of chiding—that led

FIG. 29.



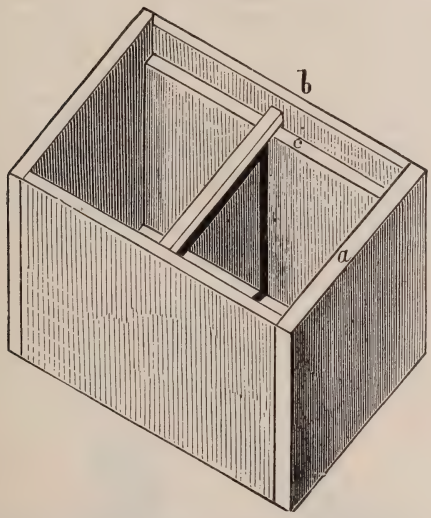
me to some of the most delightful investigations of my life. It was his invention—the Langstroth hive—that enabled me to make those investigations. For one, I shall always revere the name of Langstroth, as a great leader in scientific apiculture, both in America and throughout the world. His name must ever stand beside that of Dzierzon and the elder Huber. Surely this hive, which left the hands of the great master in so perfect a form, that even the details remain unchanged by many of our first bee-keepers, should ever bear his name. Thus, though I prefer and use the size of frame first used, I believe, by Mr. Gallup, still I use the Langstroth hive.

CHARACTER OF THE HIVE.

The main feature of the hive should be simplicity, which would exclude doors, drawers, and traps of all kinds. The body should be made of good pine or white-wood lumber, one inch thick, thoroughly seasoned, and planed on both sides. It should be simply a plain box (Fig. 30), without top or bottom, and of a size and form to suit the apiarist. The size will depend upon our purpose. If we desire no comb-honey, or desire comb-honey in frames, the hive may contain 4,000 cubic inches. If we desire honey in boxes, it should not contain over 2,000, and may be even smaller. If the hive is

to be a two-story one—that is, one hive above a similar hive below (Fig. 29)—I prefer that it should be eighteen inches long, twelve inches wide, and twelve inches deep, inside measure. If simply small frames or boxes are to be used above, I would have the hive at least two feet long. A three-fourths inch rabbet should be cut from the top of the sides or ends.

FIG. 30



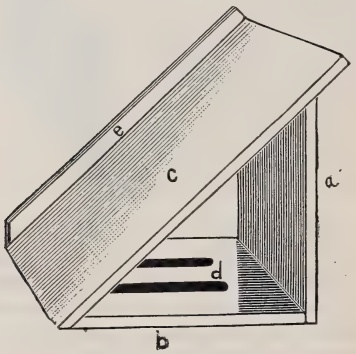
as the apiarist prefers, on the inside (Fig. 30, *c*). The rabbet may equal a little more than one-half the thickness of the board. Heavy tin strips (Fig. 33), three-fourths of an inch wide, should be tacked to the side below the rabbet, so as to reach one-fourth of an inch above the shoulder. These are to bear the frames, and are convenient, as they prevent the frames from becoming glued to the hive. We are thus able to loosen the frames without jarring the bees. I would not have hives without such tin rabbets, though some apiarists, among whom is Mr. James H. Heddon, of this State, whose rank as a successful apiarist is very high, does not like them. The objection to them is cost, and liability of the frames to

move when the hive is moved. But with their use we are not compelled to pry the frames loose, and are not so likely to irritate the bees, while making an examination of the contents of the hive, which arguments are conclusive with me.

Any one who is not a skilled mechanic, especially if he has not a buzz-saw, had better join the sides of his hives after the style of making common dry-goods boxes (Fig. 30). In this case, the sides not rabbeted should project by, else the corners will have to be stopped up where they were rabbeted.

The mechanic may prefer to bevel the ends of the boards, and unite them by a miter-joint (Fig. 33). This looks a little better, otherwise is not superior to the other method. It is difficult to form accurate joints—*and as everything about the hive should be* ACCURATE *and* UNIFORM—this style is not to be recommended to the general apiarist. To miter with a hand-saw, unless one is very skilled, requires a perfect miter-box, and even then, much care is required to secure perfect joints. With a buzz-saw this is easier. We have

FIG. 31.



Bevel-Gauge.

only to make a carrier as follows: Take two boards (Fig. 31, *a*, *b*), each one foot in length, and dove-tail them together, as though with two others you meant to make a square box. Be sure that they form a perfect right-angle. Then bevel the ends opposite the angle, and unite these with a third

board (Fig. 31, *c*), firmly nailed to the others. We thus have a triangular pyramid. Through one of the shorter faces make longitudinal slits (Fig. 31, *d*), so that this can be bolted firmly to the saw-table. In use, the longer face will reach the saw, and from thence will slant up and back. Along the back edge of this a narrow board (Fig. 31, *e*) should be nailed, which will project an inch above it. This will keep the board to be beveled in line with the carrier, and will retain the right angles. Of course the boards for the hive must be perfect rectangles, and of just the right length and width, before the bevels are cut.

Such a carrier (Fig. 31) I ordered for my Barnes' saw, from a cabinet-maker. It was made of hard wood, all three joints dove-tailed, and nicely finished, at a cost of $1.50.

In sawing the ends and sides of the hive, whether by hand or with a buzz-saw, use should be made of a guide, so that *perfect uniformity* will be secured.

THE BOTTOM BOARD.

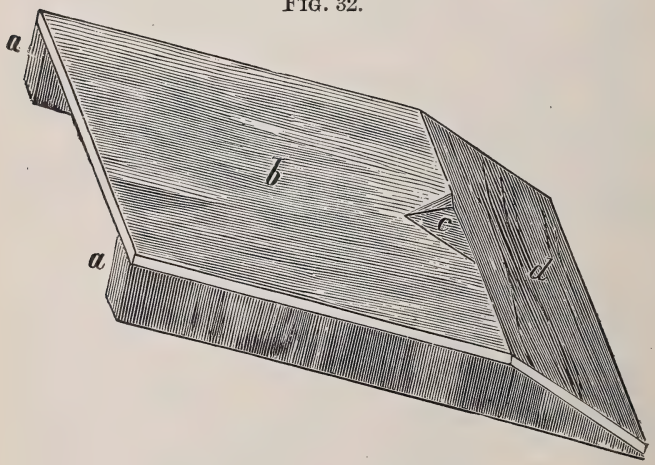
For a bottom board or stand (Fig. 32), we should have a single one-inch board (Fig. 32, *b*) just as wide as the hive, and four inches longer, if the bees are to enter at the end of the hive, and as long, and four inches wider, if the bees are to enter at the side. This is nailed to two pieces of two by four, or two by two scantling (Fig. 32, *a*, *a*). Thus the hive rests two or four inches from the ground. These scantlings should extend at one end eight inches beyond the board, and these projections be beveled from the edge of the board, to the lower outer corner of the scantling. Upon these beveled edges nail a board (Fig. 32, *d*), which shall reach from the edge of the bottom board to the ground. We thus have the alighting-board, whose upper edge should be beveled, so as to fit closely to the bottom board. If the hives are to be carried into a cellar to winter, this alighting-board (Fig. 31, *d*) had better be separate, otherwise it is more convenient to have it attached. It may be made separate at first, or may be easily separated by sawing off the beveled portion of the scantlings.

Should the apiarist desire his bees to enter at the side of the hive, the scantling (Fig. 32, *a*, *a*) should run the other

way, and the alighting-board (Fig. 32, *d*) should be longer, and changed to the side. I have tried both, and see no difference, so the matter may be controlled by the taste of the apiarist.

For an opening to the hive (Fig. 31, *c*), I would bevel the middle of the edge of the bottom board, next to the inclined board. At the edge, this bevel should be three-quarters of

FIG. 32.



an inch deep and four inches wide. It may decrease in both width and depth as it runs back, till at a distance of four inches, it is one-half an inch wide and five thirty-seconds of an inch deep. This may terminate the opening, though the shoulder at the end may be beveled off, if desired.

With this bottom board the bees are near the ground, and with the slanting board in front, even the most tired and heavily-laden will not fail to gain the hive, as they come in with their load of stores. In spring, too, many bees are saved, as they come in on windy days, by low hives and an alighting-board. *No hive should be more than four inches from the ground*, and no hive should be without the slanting alighting-board. With this opening, too, the entrance can be

contracted in case of robbing, or entirely closed when desired, by simply moving the hive back.

Some apiarists cut an opening in the side of the hive, and regulate the size by tin slides or triangular blocks (Fig. 29); others form an opening by sliding the hive forward beyond the bottom board—which I would do with the above in hot weather when storing was very rapid—but for simplicity, cheapness and convenience, I have yet to see an opening superior to the above. I think, too, I am a competent judge, as I have at least a half-dozen styles in present use.

I strongly urge, too, that only this one opening be used. Auger holes about the hive, and entrances on two sides, are worse than useless. By enlarging this opening, we secure ample ventilation, even in sultry August, and when we contract the entrance, no bees are lost by finding the usual door closed.

Some of our best bee-keepers, as Messrs. Heddon, Baldridge, etc., prefer that the bottom board be nailed to the hive (Fig. 39). I have such hives; have had for years, but strongly object to them. They will not permit a quick clearing of the bottom board, when we give a cleansing flight in winter, or when we commence operations in spring, which, especially if there is a quart or more of dead bees, is very desirable. Nor with their use can we contract the opening in cold weather, or to stop robbing, without the blocks (Fig. 29), tins or other traps. *Simplicity should be the motto in hive-making.* The arguments in favor of such fastening are: Convenience in moving colonies, and in feeding, as we have not to fasten the bottoms when we desire to ship our bees, and to feed we have only to pour our liquids into the hives.

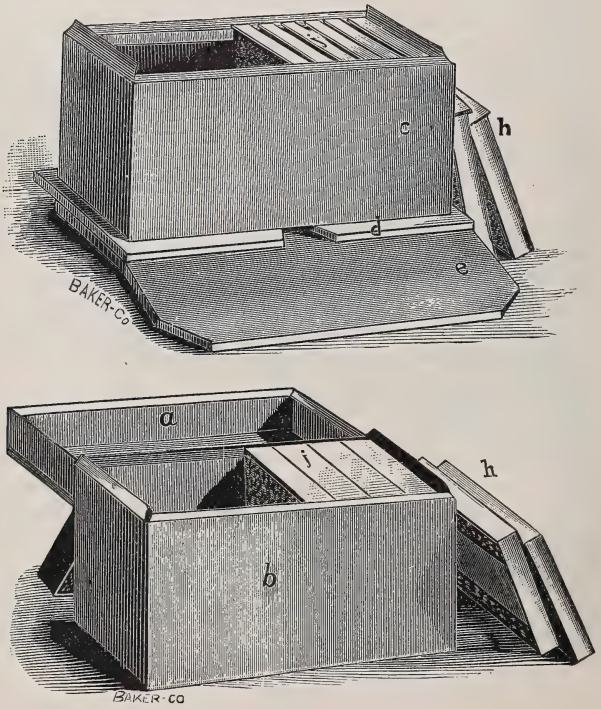
Of course, such points are not essential—only matters of convenience. Let each one decide for himself, which experience will enable him to do.

THE COVER OF THE HIVE.

The cover (Fig. 33, *a*) should be about six inches high, and like the lid of a trunk. The length and breadth may be the same as the body of the hive, and fit on with beveled edges (Fig. 33), the body having the outer edge beveled, and the cover the inner. If we thus join the cover and hive with

a mitered-joint, we must not be satisfied with anything less than perfection, else in case of storms, the rain will beat into our hives, which should never be permitted. Such covers can be fastened to the hives with hinges, or by hooks and staples. But unless the apiarist is skilled in the use of tools, or hires a mechanic to make his hives, it will be more satisfactory to make

FIG. 33.

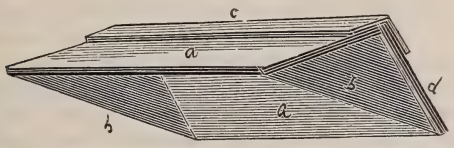


the cover just large enough (Fig. 29) to shut over and rest on shoulders formed either by nailing inch strips around the body of the hive, one inch from the top, or else inside the cover (Fig. 29). If it is preferred to have a two-story hive,

with the upper story (Fig. 33, *b*) just like the lower (Fig. 33, *c*), this (Fig. 53) may join the lower by a miter-joint, while a cover (Fig. 33, *a*) two inches high, may join this with a similar joint.

If the upper story shuts over the lower and rests on a shoulder (Fig. 29) it may still be made to take the same sized frame, by nailing pieces one-half an inch square to the corners, whose length shall equal the distance from the rabbet in the lower story to the bottom board. Now nail to these upright pieces, parallel to the rabbeted faces below, a three-eighths inch board as wide as the pieces are long. The top of these thin boards will take the place of the rabbet in the lower story. This style, which is adopted in the two-story hives as made by Mr. Langstroth (Fig. 29), will permit in the upper story the same frames as used in the lower story, while two more can be inserted. Upon this upper story a shallow cover will rest. Such covers, if desired, may be made roof-like

FIG. 34.



(Fig. 34), by cutting end pieces, (Fig 34, *b*) in form of the gable of a house. In this case there will be two slanting boards (Fig. 34, *a*, *a*), instead of one that is horizontal, to carry off the rain. The slanting boards should project at the ends (Fig. 34, *d*), for convenience in handling. In such covers we need thin, narrow ridge-boards (Fig. 34, *c*), to keep all perfectly dry. These covers look neat, are not so apt to check, and will dry much quicker after a rain.

If we secure comb-honey in crates, and winter out-doors—in which case we shall need to protect in the Northern States—it will be convenient to have a box of the same general form as the main body of the hive, from six to eight inches deep, just large enough to set over the body of the hive and rest on shoulder-strips, and without top or bottom; this to have such a cover as just described. Such is the arrange-

ment of Southard and Ranney, of Kalamazoo, which, on the score of simplicity and convenience, has much to recommend it.

In the above I have said nothing about porticos (Fig. 29). If hives are shaded as they should be, these are useless, and I believe that in no case will they pay. To be sure, they are nice for spider-webs, and a shady place in which bees may cluster; but such are inconvenient places to study the wondrous fabrics of the spider, even were he a friend of the bees, and the most successful apiarist will not force his bees to hang in idle clusters about the hive.

THE FRAMES.

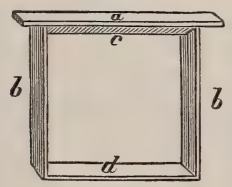
The form and size of frames, though not quite as various as the persons who use them, are still very different. Some prefer large frames. I first used one ten by eighteen inches, and afterward a shallow frame about seven by eighteen (Fig. 29). The advantage claimed for large frames is that there are less to handle, and time is saved; yet may not smaller frames be handled so much more dexterously, especially if they are to be handled through all the long day, as to compensate, in part at least, for the number? The advantage of the shallow frame is, as claimed, that the bees will go into boxes more readily; yet they are not considered so safe for out-door wintering. This is the style recommended and used by Mr. Langstroth, which fact may account for its popularity in the United States. Another frame in common use, is one about one foot square. I use one eleven inches square. The reasons that I prefer this form are, that the comb seldom breaks from the frame, the frames are convenient for nuclei, and save the expense of constructing extra nucleus hives, and that these frames permit the most compact arrangement for winter and spring, and thus enable us to economize heat. By use of a division board, we can, by using eight of these frames, occupy just a cubic foot of space in spring, and by repeated experiments I have found that a hive so constructed that the bees always cover the combs during the early cold weather, always gives the best results. As the honey season comes on more can be added, till we have reached twelve, as many, I think, as will ever be needed for brood. This was the size

frame preferred by Mr. Gallup, and is the one used by Messrs. Davis and Doolittle, and many others of our most successful apiarists. That this size is imperative is, of course, not true; that it combines as many desirable points as any other, I think, is true. For apiarists who are not very strong, especially for ladies, it is beyond question superior to all others.

HOW TO CONSTRUCT THE FRAMES.

In this description, I shall suppose that the frames desired are of the form and size (Fig. 35) which I use. It will be easy, for any who may desire, to change the form at pleasure.

FIG. 35.



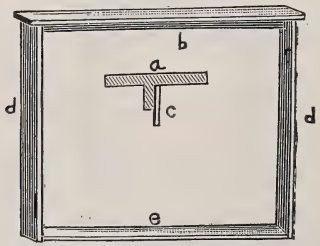
For the top bar (Fig. 35, *a*) of the frame, use a triangular strip twelve and three-quarter inches long, with each face of the triangle one inch across. One-half an inch from each end of this, form a shoulder, by sawing from one angle to within one-fourth of an inch of the opposite face, so that when the piece is split out from the end, these projections shall be just one-fourth of an inch thick throughout. For the side pieces (Fig. 35, *b*, *b*), take strips eleven inches long, seven-eighths of an inch wide, and one-fourth of an inch thick. Tack with small brads the end of two of these strips firmly to the shoulder of the top-bar, taking pains that the end touches squarely against the projection. Now tack to the opposite ends or bottoms, the ends of a similar strip (Fig. 35, *d*) eleven and a half inches long. We shall thus have a square frame.

If comb-foundation is to be used, and certainly it will be by the enterprising apiarist, then the top-bar (Fig. 36, *a*) should be twelve and three-quarters inches by one-quarter by one inch, with a rectangular, instead of a triangular, projection

below (Fig. 36, *b*), which should be one-fourth by one-eighth inch, the longest direction up and down. This should be entirely to one side of the centre, so that when the foundation (Fig. 36, *c*) is pressed against this piece it will hang exactly from the centre of the top-bar. If preferred, the bottom of the frame (Fig. 36, *e*) need not be more than half as wide or thick as described above.

The timber should be thoroughly seasoned, and of the best pine or white-wood. Care should be taken that the frame be made so as to hang vertically, when suspended on the rabbets of the hive. To secure this *very important* point—true

FIG. 36.



Frame, also Cross-Section of Top-Bar.

frames that will always hang true—they should always be made around a guide.

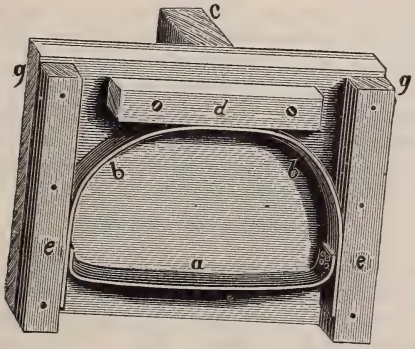
A BLOCK FOR MAKING FRAMES.

This may be made as follows: Take a rectangular board (Fig. 37) eleven and a quarter by thirteen and a half inches. On both ends of one face of this, nail hard-wood pieces (Fig. 37, *e*, *e*) one inch square and eleven inches long, so that one end (Fig. 37, *g*, *g*) shall lack one-fourth inch of reaching the edge of the board. On the other face of the board, nail a strip (Fig. 37, *c*) four inches wide and eleven and a quarter inches long, at right-angles to it, and in such position that the ends shall just reach to the edges of the board. Midway between the one inch square pieces, screw on another hard-wood strip (Fig. 37, *d*) one inch square and four inches long, parallel with and three-fourths of an inch from the edge.

To the bottom of this, screw a semi-oval piece of hoop-steel (Fig. 37, *b*, *b*), which shall bend around and press against the square strips. The ends of this should not reach quite to the bottom of the board. Near the ends of this spring, fasten, by rivets, an inch strap (Fig. 37, *a*), which shall be straight when thus riveted. These dimensions are for frames eleven inches square, inside measure, and must be varied for other sizes.

To use this block, we crowd the end-bars of our frames between the steel springs (Fig. 37, *b*, *b*) and the square strips (Fig. 37, *e*, *e*); then lay on our top-bar and nail, after which

FIG. 37.



we invert the block and nail the bottom-bar, as we did the top-bar. Now press down on the strap (Fig. 37, *a*), which will loosen the frame, when it may be removed, all complete and true. Such a gauge not only insures perfect frames, but demands that every piece shall be cut with great accuracy. And some such arrangement should always be used in making the frames.

The projecting ends of the top-bar will rest on the tins (Fig. 33), and thus the frame can be easily loosened at any time without jarring the bees, as the frames will not be glued fast, as they would in case they rested on the wooden rabbets. The danger of killing bees is also abolished by use of the tins.

When the frames are in the hive there should be at least a three-sixteenths inch space between the sides and bottom of

the frames, and the sides and bottom of the hive. Even doubling this would do no harm; though a much wider space would very likely receive comb, and be troublesome. Frames that fit close in the hive, or that reach to the bottom, are very inconvenient and undesirable. To secure against this, our lumber must be thoroughly seasoned, else when shrinkage takes place our frames may touch the bottom-board.

The distance between the frames may be one-fourth of an inch, though a slight variation either way does no harm. Some men, of very precise habits, prefer nails or wire staples in the side of the frames, at top and bottom, which project just a quarter of an inch, so as to maintain this unvarying distance; or staples in the bottom of the hive to secure the same end. Mr. Langstroth so arranged his frames, and Mr. Palmer, of Hart, Michigan, whose neatness is only surpassed by his success, does the same thing. I have had hives with these extra attachments, but found them no special advantage. I think we can regulate the distance with the eye, so as to meet every practical demand, and thus save the expense and trouble which the above attachments cost.

COVER FOR FRAMES.

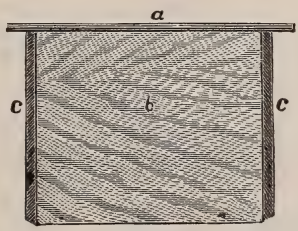
Nothing that I have ever tried is equal to a quilt for this purpose. It is a good absorbent of moisture, preserves the heat in spring and winter, and can be used in summer without jarring or crushing the bees. This should be a real quilt, made of firm unbleached factory, duck, or cambric—I have used the first with entire satisfaction for four years—enclosing a thick layer of batting, and hemmed about the edges. My wife quilts and hems them on a machine. The quilting is in squares, and all is made in less than fifteen minutes. The quilt should be a little larger than the top of the hive, so that after all possible shrinkage, it will still cover closely. Thus, when this is put on, no bees can ever get above it. When we use the feeder, it may be covered by the quilt, and a flap cut in the latter, just above the hole in the feeder, enables us to feed without disturbing the bees, though I place the feeder at the end of the chamber, wherein are the bees, and have only to double the quilt back when I feed. The only objection that I know to the quilt is, that the bees will fasten propolis,

and even comb, between it and the frames, and this looks bad. A little care will make this a small objection. Mr. Langstroth used a board above the frames, which Mr. Heddon uses even now. Perhaps Mr. Heddon never used the quilts. Perhaps his love of order and neatness caused him to discard them. Still, I feel to thank Mr. A. I. Root for calling my attention to quilts.

DIVISION BOARD.

A close-fitting division board (Fig. 38) for contracting the chamber, is very important, and though unappreciated by many excellent apiarists, still no hive is complete without it.

FIG. 38.



I find it especially valuable in winter and spring, and useful at all seasons. This is made the same form as the frames, though all below the top-bar—which consists of a strip thirteen inches long by one inch by three-eighths, and is nailed firmly to the board below—is a solid inch board (Fig. 38, *b*), which is exactly one foot square, so that it fits closely to the inside of the hive. If desired, the edges (Fig. 38, *c*, *c*) can be beveled, as seen in the figure. When this is inserted in the hive it entirely separates the chamber into two chambers, so that an insect much smaller than a bee could not pass from the one to the other. Mr. A. I. Root makes one of cloth, chaff, etc. Yet, I think few apiarists would bother with so much machinery. Mr. W. L. Porter, Secretary of the Michigan Association, makes the board a little loose, and then inserts a rubber strip in a groove sawed in the edges. This keeps the board snug, and makes its insertion easy, even though heat may shrink or damp may swell either the board or hive. I have not tried this, but like the suggestion.

The use of the division board is to contract the chamber in winter, *to vary it so as to keep combs covered in spring*, to convert the hive into a nucleus hive, and to contract the chamber in the upper-story of a two-story hive, when first adding frames to secure surplus comb-honey.

THE HUBER HIVE.

The other type of hives originated when Huber hinged several of his leaf or unicomb hives together, so that the frames would open like the leaves of a book; though it has been stated that the Grecians had, in early times, something similar.

In 1866, Mr. T. F. Bingham, then of New York, improved upon the Huber hive, securing a patent on his triangular frame hive. This, so far as I can judge, was the Huber hive made practical.

In 1868, Mr. M. S. Snow, then of New York, now of Minnesota, procured a patent on his hive, which was essentially the same as the hives now known as the Quinby and Bingham hives.

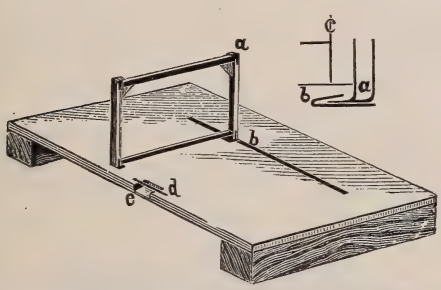
Soon after, the late Mr. Quinby brought forth his hive, which is essentially the same as the above, only differing in details. No patent was obtained by Mr. Quinby, whose great heart and boundless generosity endeared him to all acquaintances. Those who knew him best, never tire of praising the unselfish acts and life of this noble man. If we except Mr. Langstroth, no man has probably done so much to promote the interest and growth of improved apiculture in the United States. His hive, his book, his views of wintering, his introduction of the bellows-smoker—a gift to apiarists—all speak his praise as a man and an apiarist.

The fact that the Bingham hive, as now made, is a great favorite with those who have used it, and is pronounced by so capable a judge as Mr. Heddon, to be the best movable-comb hive in existence, that Mr. Quinby preferred this style or type of hive, that the Quinby form is used by the Hetherington brothers, Captain J. E., the prince of American apiarists, and O. J., whose neatness, precision, and mechanical skill are enough to awaken envy; that the Russell hive is but a

modification of the same type, are surely enough to awaken curiosity and bespeak a description.

The Quinby hive (Fig. 39), as used by the Hetherington brothers, consists of a series of rectangular frames (Fig. 39) twelve by seventeen inches, outside measure. The ends of these frames are one and a half inches wide and half an inch thick. The top and bottom one inch wide and half an inch thick. The outer half of the ends projects one-fourth of an inch beyond the top and bottom. This projection is lined with sheet iron, which is inserted in a groove which runs one inch into each end of the end-pieces and are tacked by the same

FIG. 39.



Frame, Bottom-Board and Frame-Support of Quinby Hive.

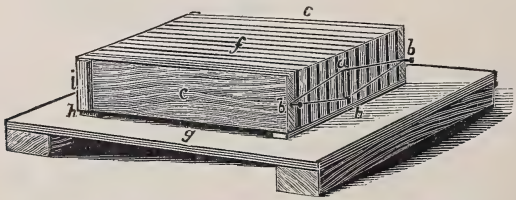
nails that fasten the end-bars to the top and bottom-bars. This iron at the end of the bar bends in at right-angles (Fig. 39, *a*, *a*), and extends one-fourth of an inch parallel with the top and bottom-bars. Thus, when these frames stand side by side, the ends are close, while half-inch openings extend between the top and bottom-bars of adjacent frames. The bottom-bars, too, are one-fourth of an inch from the bottom-board. Tacked to the bottom-board, in line with the position of the back end-bars of the frames is an inch strip of sheet-iron (Fig. 39, *b*, *b*) sixteen inches in length. One-third of this strip, from the front edge back, is bent over so it lies not quite in contact with the second third, while the posterior third receives the tacks which hold it to the bottom-board. Now, when in use this iron flange receives the hooks on the corners of the frames, so that the frames are held firmly, and can only

be moved back and side-wise. In looking at the bees we can separate the combs at once, at any place. The chamber can be enlarged or diminished simply by adding or withdrawing frames. As the hooks are on all four corners of the frames, the frames can be either end back, or either side up. Boards with the iron hooks close the sides of the brood cavity, while a quilt covers the frames.

The entrance (Fig. 39, *e*) is cut in the bottom-board as already explained, except that the lateral edges are kept parallel. A strip of sheet-iron (Fig. 39, *d*) is tacked across this, on which rest the ends of the front end-bars of the frames which stand above, and underneath which pass the bees as they come and go from the hive. A box, without bottom and with movable top, covers all, leaving a space from four to six inches above and on all sides between it and the frames. This gives chance to pack with chaff in winter, and for side and top storing in sections or boxes in summer.

The Bingham hive (Fig. 40) is not only remarkably simple, but is as remarkable for its shallow depth; the frames being only five inches high. These have no bottom-bar. The end-

FIG. 40.



Frames and Bottom-Board of the Bingham Hive.

bars are one and a half inches wide, and the top-bar square. The nails that hold the end-bars pass into the end of the top-bar, which is usually placed diagonally, so that an edge, not a face, is below; though some are made with a face below (Fig. 40, *f*), to be used when comb is transferred. The frames are held together by two wires, one at each end. Each wire (Fig. 40, *a*) is a little longer than twice the width of the hive when the maximum number of frames are used. The ends of each wire are united and placed about nails (Fig. 40, *b*, *b*) in

the ends of the boards (Fig. 40, *c*, *c*) which form the sides of the brood-chamber. A small stick (Fig. 40, *a*) spreads these wires, and brings the frames close together. A box without bottom and with movable cover, is placed about the frames. This is large enough and high enough to permit of chaff packing in winter and spring. The bottom-board may be made like the one already described. Mr. Bingham does not bevel the bottom-board, but places lath under three sides of the brood-chamber, the lath being nailed to the bottom-board —and then uses the blocks to contract the entrance (Fig. 40, *g*.)

The advantages of this hive are, simplicity, great space above for surplus frames or boxes, capability of being placed one hive above another to any height desired, while the frames may be reversed, end for end, or bottom for top, or the whole brood-chamber turned up-side down. Thus, by doubling, we may have a depth of ten inches for winter.

The objection which I have found in the similar Russell hive, is danger of killing bees in rapid handling. In the Russell hive the side-bars are halved together, and held in place by ingeniously contrived wire hooks. There are no bottom-bars. I have used none of these except the Russell. They can be manipulated with rapidity, if we care not how many bees we crush. It hurts me to kill a bee, and so I find the Langstroth style more quickly manipulated. Mr. Snow, too, who was the first to make the above style of hive, has discarded it in favor of the Langstroth. His objection to the above, is the fact that the various combs are not sure to be so built as to be interchangeable. He also says in his letter, that Mr. Langstroth has done more for apiculture in the United States than *all* others, to which I can say amen. Yet that such apiarists as those above named prefer these Huber hives, after long use of the other style, is certainly not without significance.

APPARATUS FOR PROCURING COMB-HONEY.

Although I feel sure that extracted-honey will grow more and more into favor, yet it will never supersede the beautiful comb, which, from its exquisite flavor and attractive appearance, has always been, and always will be, admired and desired.

So, no hive is complete without its arrangement of boxes, section-frames, and crates, all constructed with the view of securing this delectable comb-honey in the form that will be most irresistible.

BOXES.

These are for surplus comb-honey in the most salable form. They may be of any size that best suits the taste of the apiarist, and the pulse of the market.

It is well that the sides of these be of glass. Such (Fig. 41) may be made as follows: For top and bottom procure soft-wood boards one-fourth of an inch thick and of the size

FIG. 41.

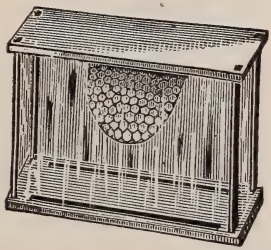


desired, one for the bottom and the other for the top of the box. Take four pieces half an inch square and as long as the desired height of the honey-box. In two adjacent sides of these saw grooves in which may slip common glass. These are for corner pieces. Now tack with small brads the corners of the bottom-board to the ends of these pieces, then slide in the glass, and in similar way tack the top-board to the other ends. Through the bottom-board holes may be bored so that the bees may enter. A similar box is made by A. H. Russell, of Adrian, Mich., except that tin forms the corners. These may be made to take from one to three combs, and are certainly very attractive. If made small and set in a crate so that all could be removed at once, they would leave little to be desired.

The Isham box (Fig. 42) is essentially like the Russell; only the tin at the corners is fastened differently. Surely, all great minds do run in the same channel. Another form (Fig. 43) which I find very desirable, and which I used in California (where they were introduced by Mr. Harbison) more than ten years ago, is made as follows: Dress off common lath so that they are smooth, cut off two lengths the desired height of the box, and one the desired width; tack this last piece to the ends of the other two, and to the other end tack a similar strip

only half as wide. We now have a square frame. Place such frames side by side till a box is made of the desired length. To hold these together, we have now only to tack on either side one or two pieces of tin, putting a tack into each section, thus forming a compact box without ends. The end frames

FIG. 42



should have a whole piece of lath for the bottom, and grooves should be cut in the bottom and top laths, so that a glass may be put in the ends. Of course there is ample chance for the bees to enter from below. Now, by placing small pieces of comb, or artificial comb foundation, which ranks as a discovery with the movable-frame hive and honey-extractor, on the top of each frame (Fig. 43), the bees will be led to construct a separate comb in each frame, and each frame may be sold by the retail dealer separately, by simply drawing the tacks from the tins. Barker and Dicer, of Marshall, Michigan, make a very neat sectional honey-box, which is quite like the above, except that paper pasted over the frames takes the place of

FIG. 43.



the tins. These, too, have wood separators as used and sold by the gentlemen named. The honey-boxes may be placed directly on the frames, or in case the queen makes trouble by entering them to deposit eggs—a trouble which I have seldom

met, perhaps because I give her enough to do below—we can place strips one-fourth of an inch square between the frames and boxes. In case we work extensively for box honey, we should have a rack or crate so made that we can remove all the boxes at once ; in which case to examine the bees we would not have to remove all the boxes separately.

SURPLUS COMB-HONEY IN SMALL FRAMES.

Honey in boxes, unless they consist of sections as just described, cannot compete with honey in small frames, in our present markets, and without doubt they will fall more and more into disfavor. In fact, there is no apparatus for securing comb-honey that promises so well as these sections. That they are just the thing to enable us to tickle the market is shown by their rapid growth in popular favor. Three years ago I predicted, at one of our State Conventions, that they would soon replace boxes, and was laughed at. Nearly all who then laughed, now use these sections. They are cheap, and with their use we can get more honey, and in a form that will make it irresistable.

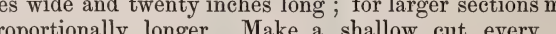
REQUISITES OF GOOD SECTIONS

The wood should be *white*, the size small, from four to six inches square, the sections capable of being glassed, at least on the faces, not too much cut off from brood-chamber, cheap, easily made, and so arranged as to be put on or taken off the hive *en masse*.

DESCRIPTION.

The style of section which I think will soon replace all others, is easily made, as follows : For a section four inches square take a strip of *clean*, *white* veneer—cut from bass-wood, poplar or white-wood—such as is used to make berry-boxes, two inches wide and twenty inches long ; for larger sections make it proportionally longer. Make a shallow cut every four

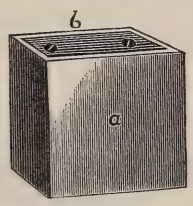
FIG. 44.



inches at right-angles to the sides—though they will do this, if asked to, at the factory. Now with a chisel (Fig. 44) four inches long, with one-eighth inch projections at right-angles

to the main blade, cut out sections on the opposite edges of the main strip—which will leave openings one-eighth inch by four inches, between the first and second shallow cut and the third and fourth. We now bend this around a square block (Fig. 45) which will just fill it, letting the ends over-lap, and drive through these over-lapping sections one or two small wrought brads on to an iron, (Fig. 45, *b*) set into the block,

FIG. 45.



by which they will be clinched. Or, by using glue, we may dispense with the block. Now, if your market requires glassed sections, or if you wish to insert dividers, either tin or wood, glue posts one-fourth of an inch square, four in each section along the uncut sides one-eighth inch from the edges. The ends of these will just come flush with the gouged edges above and below. Now, by use of tins such as are used to fasten window-glass, these can be glassed, or if desired, each one can receive a tin or wooden separator.

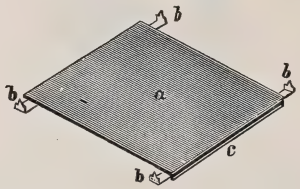
If this gluing in of the pieces is thought too troublesome, we may still achieve the same end by using tin separators in our crates, and then glass our sections by cutting a square glass, just the size of the section, outside measure, and with heavy white paper paste two of these glass to the sections. This makes each section perfectly close, and is the method devised by Southard and Ranney for practice the coming season. A paste made of dextrine, tragacanth, or even flour, will answer to fasten the strips of paper, which need not be more than one inch wide. A little carbolic acid, or salicylic acid in solution, will keep the paste from souring.

Every apiarist can make these sections for himself, and thus save freight and profits of making. They are neat, very cheap —costing but two mills each—and are made strong by use of the glued posts. They are also light. Very soon our cus-

tomers will object to buying wood and glass, if our unglassed sections of comb-honey are kept in close glassed crates.

The Hetherington brothers make a very neat section, as follows: The top and bottom are each two inches wide, of one-quarter inch white pine. These receive a groove one-eighth inch from the ends, which receives the sides, one inch wide and one-eighth inch thick, which is pressed through to a central position and glued. This section is five and a half inches square. They use wooden dividers (Fig. 46, *a*) one-

FIG. 46.



eighth of an inch thick, as long as the section, but one inch less in height, so that below and above is a half-inch space, which permits the bees to pass readily from one section to another. These are held by a half-inch strip of tin (Fig. 46, *b*, *b*), which passes through a groove (Fig. 46, *c*) in the ends of the dividers, and reaches half an inch farther; then turns at right-angles and ends in a point (Fig. 46, *b*), which, when in use, sticks into the top or bottom pieces; and so the four points hold the dividers in place. When ready to sell, they insert half-inch glass in the grooves each side the narrow side-pieces, and with tins fasten glass on the faces, and have a

FIG. 47.



very handsome section. I think this preferable to the Russell or Isham box or section, as the one-inch strip of wood covers the part of the comb where it is fastened to the sides, which is never attractive, while the rest is all glassed. Such sec-

tions were praised in New York and Cincinnati last season as very fine and neat ; equal, if not superior, to all others.

A. I. Root prefers sections made as are children's toy blocks, the sides fastened by a sort of mortise and tennon arrangement (Fig. 47). I have received from Mr. James H. Heddon a similar section, but neater and more finished, which is made in Vermont. These are too complex to be made without machinery, are no better for their fancy corners—in fact, they are not as strong as is desirable—and, as we cannot afford to purchase our apparatus when we can as well make it ourselves, I cannot recommend them for general use.

The Phelps-Wheeler-Betsinger sections (Fig. 48) are essentially the same. The top and bottom are a little more narrow than the sides, and are nailed to them. The Wheeler

FIG. 48.



section—invented and patented by Mr. Geo. T. Wheeler, Mexico, New York, in 1870—are remarkable for being the first (Fig. 52, *K*) to be used with tin separators (Fig. 52, *M*). Instead of making the bottoms one-quarter of an inch narrower for a passage, Mr. Wheeler made an opening in the bottom, as does Mr. Russell.

HOW TO PLACE SECTIONS IN POSITION.

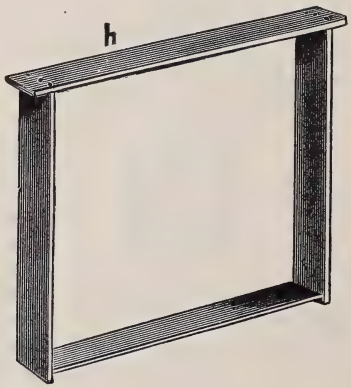
There are two methods, each of which is excellent, and has, as it well may, earnest advocates—one by use of crates, the other by frames.

HONEY IN FRAMES.

I prefer this method, perhaps because I have used it most. These frames (Fig. 49) are made the same size as the frames in the brood-chamber, except that they are made of strips two inches wide, and one-fourth of an inch thick, though the bottom-bar is a quarter of an inch narrower, so that when two frames are side by side, there is one-fourth of an inch space between

the bottom bars, though the top and side pieces are close together. The sections are of such a size (Fig. 50, *K*) that four, or six, or nine, etc., will just fill one of the large frames. Nailed to one side of each large frame are two tin strips (Fig. 50, *t*, *t'*) as long as the frame, and as wide into one inch as are the sections. These are tacked half an inch from the top and the bottom of the large frames, and so are opposite the sections, thus permitting the bees to pass readily from one tier of sections to another, as do the narrower top and

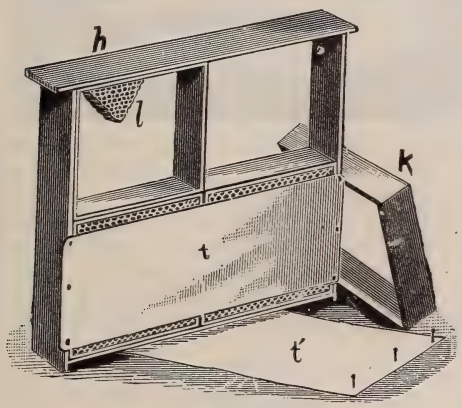
FIG. 49.



bottom-bars of the sections, from those below to those above. I learned of such an arrangement of sections from A. I. Root. Captain Hetherington tells me that Mr. Quinby used them years ago. The tin arrangement, though unlike Mr. Wheeler's (Fig. 52, *M*), would be readily suggested by it. It is more trouble to make these frames if we have the tins set in so as just to come flush with the edge of the end-bars of the frames, but then the frames would hang close together, and would not be so stuck together with propolis. These may be hung in the second story of a two-story hive, and just so many as to fill the same—my hives will take nine—or they can be put below, beside the brood-combs. Mr. Doolittle, in case he hangs these below, inserts a perforated division-board,

so that the queen will not enter the sections and lay eggs. I used them very successfully last summer without division-boards, and neither brood nor pollen were placed in a single cell. Perhaps wider tins would prevent this should it occur. In long hives—the "New Idea"—which I find very satisfactory, after several years' trial, especially for extracted honey—I have used these frames of sections, and with the best success. The Italians entered them at once, and filled them even more quickly than other bees filled the sections in the upper story. In fact, one

FIG. 50.



great advantage of these sections in the frames is the obvious and ample passage-ways, inviting the bees to enter them. But in our desire to make ample and inviting openings, caution is required that we do not over-do the matter, and invite the queen to injurious intrusion. So we have Charybdis and Scylla, and must, by study, learn to so steer between, as to avoid both dangers.

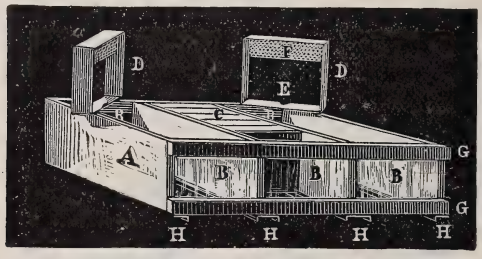
RACKS.

These are to use in lieu of large frames, to hold sections, and are very convenient when we wish to set the sections only one deep above the brood-chamber. Though, if desired, we

can place one rack above another, and so have sections two, and even three deep.

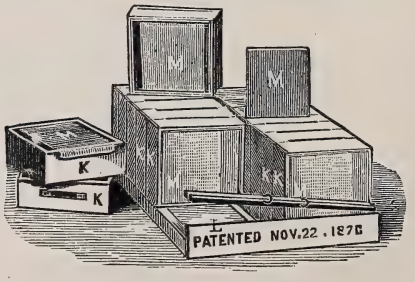
Southard and Ranney, of Kalamazoo, use a very neat rack (Fig. 51), in which they use the thin veneer sections which we recommend as superior to all others for the general apiarist.

FIG. 51.



They have used these with excellent success, but without separators, which they wish to insert. Perhaps by taking out the board partitions (Fig. 51, *B*, *B*), and putting tin separators the other way across, they would accomplish their object. In this case, the ends of the adjacent sections would not be separated, and the width of the rack would just accommodate two, three, or four sections, to be governed by size of hive and sections. The sheet-iron rests (Fig. 51, *H*, *H*, *H*)

FIG. 52.



which, with their bent edges, just raise the rack one-fourth of an inch from the brood frames, would then run the other

way, and give the requisite strength. Thus, the tins would not be liable to bend, as they would if run the shorter way of the rack. The end-board, too (Fig. 51. *A*), would be a side-board, and the strips (Fig. 51, *G*, *G*), with the intervening glass, would be at the ends.

The Wheeler rack (Fig. 52) simply holds the sections, while each section is glassed separately.

Captain Hetherington sets a rack of sections above the frames, and stands sections one above the other on the side for side storing. Mr. Doolittle makes a rack by placing frames, such as I have described—except they are only half as high, and hold but two sections—side by side, where they are held by tacking a stick on top across each end of the row. He also places two tiers, two deep, at each end of the brood-chamber, if he desires to give so much room.

All apiarists who desire to work for comb honey which will sell, will certainly use the sections, and either adjust them by use of frames or crates.

FOOT-POWER SAW.

Every apiarist who keeps upwards of fifty colonies of bees, and makes apiculture a specialty, will find a foot power saw a very valuable apparatus.

I have now used the admirable combined foot-power saw of W. F. & John Barnes for a year, and find that it grows in value each month. It permits rapid work, insures uniformity, and enables the apiarist to give a finish to his work that would rival that of the cabinet-maker.

Those who procure such a machine should learn to file and set the saws, and should *never* run the machine when not in perfect order.

CHAPTER VI.

POSITION AND ARRANGEMENT OF APIARY.

As it is desirable to have our apiary grounds so fixed as to give the best results, and as this costs some money and more labor, it should be done once for all. As plan and execution in this direction must needs precede even the purchase of bees, this subject deserves an early consideration. Hence, we will proceed to consider position, arrangement of grounds, and preparation for each individual colony.

POSITION.

Of course, it is of first importance that the apiary be near at hand. In city or village this is imperative. In the country or at suburban homes, we have more choice, but close proximity to the house is of much importance. In a city, it may be necessary to follow friend Muth's example, and locate on the house-tops, where, despite the inconvenience, we may achieve success. The lay of the ground is not important, though if a hill, it should not be very steep. It may slope in any direction, but better any way than toward the north.

ARRANGEMENT OF GROUNDS.

Unless sandy, these should be well drained. If a grove offers inviting shade, accept it, but trim high to avoid damp. Such a grove could soon be formed of bass-wood and tulip trees, which, as we shall see, are very desirable, as their bloom offers plenteous and most delicious honey. Even Virgil urges shade of palm and olive, also that we screen the bees from winds. Wind-screens are very desirable, especially on the windward side. Such a screen may be formed of a tall board fence, which, if it surrounds the grounds, will also serve to protect against thieves. Yet these are gloomy and forbidding, and will be eschewed by the apiarist who has an eye to æsthetics. Ever-green screens, either of Norway spruce, Austrian or other pine, or arbor vitæ, each or all, are not only very effective, but are quickly grown, inexpensive, and add

greatly to the beauty of the grounds. If the apiary is large, a small, neat, inexpensive house, in the centre of the apiary, grounds is indispensable. This will serve in winter as a shop for making hives, frames, etc., and as a store-house for honey, while in summer it will be used for extracting, transferring, storing, bottling, etc. In building this, it will be well to construct a frost-proof, *thoroughly drained*, dark, and well-ventilated cellar. To secure the thorough ventilation, pass a tube, which may be made of tile, from near the bottom, through the earth to the surface; and another, from near the bottom, to the chimney or stove-pipe above.

PREPARATION FOR EACH COLONY.

Virgil was right in recommending shade for each colony. Bees are forced to cluster outside the hive, where the hives are subjected to the full force of the sun's rays. By the intense heat, the temperature inside becomes like that of an oven, and the wonder is that they do not desert entirely. I have known hives, thus unprotected, to be covered by bees, idling outside, when by simply shading the hives, all would go merrily to work. The combs, too, and foundation especially, are liable, in unshaded hives, to melt and fall down, which is very damaging to the bees, and very vexatious to the apiarist. The remedy for all this is to always have the hives so situated that they will be entirely shaded all through the heat of the day. This might be done by constructing a shed or house, but these are expensive and inconvenient, and, therefore, to be discarded. Perhaps the Coe house-apiary (Chap. XVIII) may prove an exception; but, as yet, we have no reliable assurance of the fact.

If the apiarist has a convenient grove, this may be trimmed high, so as not to be damp, and will fulfill every requirement. So arrange the hives that while they are shaded through all the heat of the day, they will receive the sun's rays early and late, and thus work more hours. I always face my hives to the east. If no grove is at command, the hives may be placed on the north of a Concord grape-vine, or other vigorous variety, as the apiarist may prefer. This should be trained to a trellis, which may be made by setting two posts, either of cedar or oak. Let these extend four or five feet above the ground, and be three or four feet apart. Connect them at intervals of

eighteen inches with three galvanized wires, the last one being at the top of the posts. Thus we can have shade and grapes, and can see for ourselves that bees do not injure grapes. If preferred, we may use evergreens for this purpose, which can be kept low, and trimmed square and close on the north. These can be got at once, and are superior in that they furnish ample shade at all seasons. Norway spruce is the best. These should be at least six feet apart. A. I. Root's idea of having the vines of each succeeding row divide the spaces of the previous row, in quincunx order, is very good; though I should prefer the rows in this case to be four, instead of three feet apart, especially with ever-greens. Until protecting shade can be thus permanently secured, boards should be arranged for temporary protection. Many apiarists economize by using fruit trees for this purpose, which, from their spreading tops, answer very well.

Mr. A. I. Root's idea of having sawdust under and about the hives is, I think, a good one. The hives of the Michigan Agricultural College (Fig. 53) are protected by evergreens, trimmed close on the north side. A space four feet by six, north of the shrubs, was then dug out to a depth of four inches, and filled with sawdust (Fig. 53, *f*), underlying which were old bricks, so that nothing would grow up through the sawdust. The sawdust thus extends one foot back, or west of the hive, three feet north, and the same distance to the east or front side of the hive. This makes it neat about the hive, and largely removes the danger of losing the queen in handling the bees; as should she fall outside the hive, the sharp-sighted apiarist would be very likely indeed to see her.

Mr. J. H. Nellis, the able Secretary of the North-Eastern Bee-Keepers' Association, objects to sawdust, as he thinks it rots too quickly, and blows about badly. He would use sand or gravel instead. I have tried both gravel and sawdust, and prefer the latter, as explained above. By having the sawdust a little below the general surface, and adding a little once in four or five years, it keeps all nice and agreeable. After the evergreens are well started, all the space between the sawdust areas should be in grass, and kept neatly mown. This takes but a little time, and makes the apiary always pleasant and inviting.



FIG. 53.

CHAPTER VII.

TO TRANSFER BEES.

As you may have purchased your bees in box hives, and so, of course, will desire to transfer them immediately into movable-frame hives, or, as already suggested, you may wish to transfer from one movable-frame to another, I will now proceed to describe the process.

The best time to transfer is early in the season, when there is but little honey in the hives, though it may be done at any time, if sufficient caution is used; still it should never be done except on warm days, when the bees are actively engaged in storing. After the bees are busy at work, approach the old hive, blow a little smoke into the entrance to quiet the bees, then carry the hive off a few feet, and turn it bottom up. Place a box over the hive—it will make no difference whether it fits it close or not, if the bees are so smoked as to be thoroughly alarmed—and with a stick rap on the lower hive for about twenty minutes. The bees will fill with honey and go with the queen into the upper hive and cluster. If towards the last we carefully set the box off once or twice, and vigorously shake the hive, and then replace the box, we will hasten the emigration of the bees, and make it more complete. I got this suggestion from Mr. Baldridge. A few young bees will still remain in the old hive, but these will do no harm. Now put the box on the old stand, leaving the edge raised so that the bees which were out may enter, and so all the bees can get air. If other bees do not trouble, as they usually will not if busily gathering, we can proceed in the open air. If they do we must go into some room. I have frequently transferred the comb in my kitchen, and often in a barn. Now knock the old hive apart, cut the combs from the sides, and get the combs out of the old hive with just as little breakage as possible. Mr. Baldridge, if transferring in

spring, saws the combs and cross-sticks loose from the sides, turns the hive into the natural position, then strikes against the top of the hive with a hammer till the fastenings are broken loose, when he lifts the hive, and the combs are all free and in convenient shape for rapid work.

We now need a barrel, set on end, on which we place a board fifteen to twenty inches square, covered with several thicknesses of cloth. Some apiarists think the cloth useless, but it serves, I think, to prevent injury to comb, brood or honey. We now place a comb on this cloth, and a frame on the comb, and cut out the comb the size of the inside of the frame, taking pains to save all the brood. Now crowd the frame over the comb, so that the latter will be in the same position that it was when in the old hive ; that is, so the honey will be above—the position is not very important—then fasten the comb in the frame, by winding about all one or two small wires or pieces of wrapping twine. To raise the frame and comb before fastening, raise the board beneath till the frame is vertical. Set this frame in the new hive, and proceed with the others in the same way till we have all the worker-comb—that with small cells—fastened in. To secure the pieces, which we shall find abundant at the end, take thin pieces of wood, one-half inch wide and a trifle longer than the frame is deep, place these in pairs either side the comb, extending up and down, and enough to hold the pieces secure till the bees shall fasten them, and secure the strips by winding with small wire, just above and below the frame, or else tack them to the frame with small tacks.

Captain Hetherington has invented and practices a very neat method of fastening comb into frames. In constructing his frames, he bores small holes through the top, side, and bottom-bars of his frames, about two inches apart ; these holes are just large enough to permit the passage of the long spines of the hawthorn. Now, in transferring comb, he has but to stick these thorns through into the comb to hold it securely. He can also use all the pieces, and still make a neat and secure frame of comb. He finds this arrangement convenient, too, in strengthening insecure combs. In answer to my inquiry, this gentleman said it paid well to bore such holes in all his frames, which are eleven by sixteen inches,

inside measure. I discarded such frames because of the liability of the comb to fall out.

Mr. Baldridge makes wads of comb, or comb-cappings, which he finds good, and by pressing these against the edges of the comb he wishes to fasten, he fastens them to the frames, quickly and securely.

Having fastened all the worker-comb that we can into the frames—of course all the other, and all bright drone-comb, will be preserved for use as guide-comb—and placed the frames in the new hive—these should be put together if they contain brood, especially if the colony is not very strong, and the empty frames to one side—we then place our hive on the stand, pushing it forward so that the bees can enter anywhere along the alighting-board, and then shake all the bees from the box, and any young bees that may have clustered on any part of the old hive, or on the floor or ground, where we transferred the comb, immediately in front. They will enter at once and soon be at work, all the busier for having passed "from the old house into the new." In two or three days, remove the wires or strings and sticks, when we shall find the combs all fastened and smoothed off, and the bees as busily engaged as though their present home had always been the seat of their labors. In case we practice the methods of either Captain Hetherington or Mr. Baldridge, there will be nothing to remove, and we need only go and congratulate the bees in view of their new and improved home.

Of course, in transferring from one frame to another, the matter is much simplified. In this case, after thoroughly smoking the bees, we have but to lift the frames, and shake or brush the bees into the new hive. For a brush, a chicken or turkey wing, or a large wing or tail feather from a turkey, goose or peacock, serves admirably. Now, cut out the comb in the best form to accommodate the new frames, and fasten as already suggested. After the combs are all transferred, shake all remaining bees in front of the new hive, which has already been placed on the stand previously occupied by the old hive.

CHAPTER VIII.

FEEDING AND FEEDERS.

As already stated, it is only when the worker-bees are storing that the queen deposits to the full extent of her capability, and that brood-rearing is at its height. In fact, when storing ceases, general indolence characterizes the hive. Hence, if we would achieve the best success, we must keep the workers active, even before gathering commences, as also in the interims of honey secretion by the flowers; and to do this we must feed sparingly before the advent of bloom in the spring, and whenever the neuters are forced to idleness during any part of the season, by the absence of honey-producing flowers. For a number of years, I have tried experiments in this direction by feeding a portion of my colonies early in the season, and in the intervals of honey-gathering, and always with marked results in favor of the practice.

Every apiarist, whether novice or veteran, will receive ample reward by practicing stimulative feeding early in the season; then his hive at the dawn of the white clover era will be redundant with bees, well filled with brood, and in just the trim to receive a bountiful harvest of this most delicious nectar.

Feeding, too, is often necessary to secure sufficient stores for winter—for no apiarist, worthy the name, will suffer his faithful, willing subjects to starve, when so little care and expense will prevent it.

HOW MUCH TO FEED.

If we only wish to stimulate, the amount fed need not be great. A half pound a day, or even less, will be all that is necessary to encourage the bees to active preparation for the good time coming. For information in regard to supplying stores for winter see Chapter XVII.

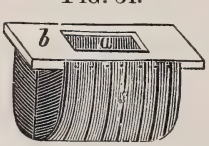
WHAT TO FEED.

For this purpose I would feed coffee A sugar, reduced to the consistency of honey, or else extracted honey kept over from the previous year. The price of the latter will decide which is most profitable. Honey, too, that has been drained or forced out of cappings, etc., is good, and only good to feed. Many advise feeding the poorer grades of sugar in spring. My own experience makes me question the policy of ever using such feed for bees. The policy, too, of feeding glucose I much question. In all feeding, unless extracted honey is what we are using, we cannot exercise too great care that such feed is not carried to the surplus boxes. Only let our customers once taste sugar in their comb-honey, and not only is our own reputation gone, but the whole fraternity is injured. In case we wish to have our combs in the sections filled or capped, we must feed extracted honey, which may often be done with great advantage.

HOW TO FEED.

The requisites of a good feeder are: Cheapness, a form to admit quick feeding, to permit no loss of heat, and so arranged that we can feed without in any way disturbing the bees. The feeder (Fig. 54) which I have used with the best

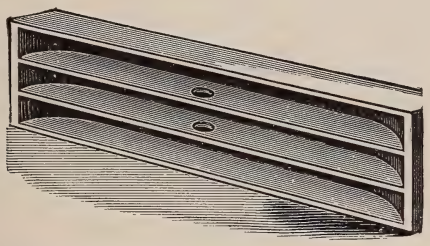
FIG. 54.



satisfaction, is much the form of a frame of comb with the lower half cut off. The top-bar (Fig. 54, *b*) is twelve and three-fourths inches long, two inches wide and one-half inch thick, with a central hole (Fig. 54, *c*) one inch wide by three long. Tacked to the edge of this top-bar is a bag made of drilling, which should not reach nearer the ends than one inch, and should not be more than half as deep as the hive. This is put into a hive either at the end or between the frames. If at the end, and a quilt is used to

cover the frames, the quilt need not extend over the feeder, but tuck in closely beside it, thus precluding any bees gaining entrance to the feeder. If it is placed between other frames, the quilt should rest on the top-bar of the feeder, and should have a hole or flap cut in it immediately above the hole in the bar. If a honey-board is used, the bar of the feeder can be fastened to the honey-board, with the hole immediately beneath the same in the honey-board. Now, to feed, we have only to raise the top of the hive, and by use of a tin pail with a long spout, turn in our feed. As the bees cannot get above, they cause us no trouble, and the feeding becomes a matter of great ease and rapidity. The drilling should be just fine enough to permit the syrup to ooze through. I have even used very closely woven unbleached factory. These feeders

FIG. 55.



can be washed out when not in use, and can be used for feeding whenever it is desired, for whatsoever purpose.

Some apiarists prefer a quart tin can with finely perforated cover. This is filled with liquid, the cover put on, and the whole quickly inverted and set above a hole in the quilt. Owing to the pressure of the air, the liquid will not descend so rapidly that the bees cannot sip it up.

Many other styles of feeders are in use, as the Simplicity (Fig. 55), etc., but for cheapness and convenience, I know of none equal to the one figured and described above.

Mr. Root, for summer feeding, prefers to feed at night, and sets the feed in front of the hive close to the entrance. The bees during the night carry all the liquid into the hive. For such feeding, a circular vessel, made by cutting a cavity six

inches in diameter and one and a half inches deep, in a circular section of a two inch plank eight inches in diameter, and containing a float full of one-half inch holes, would be very convenient. But such a feeder could not be used in spring, and would not be good for use inside above the quilt, and as we could not afford to have two feeders, where only one is really needed, I think we cannot afford to feed outside, unless we can invent a cheap feeder which can be used conveniently in both positions.

In feeding during the cold days of April, all should be close above the bees to economize the heat. In all feeding, care is requisite, that we may not spill the feed about the apiary, as this may, and very generally will, induce robbing.

CHAPTER IX.

QUEEN REARING.

Suppose the queen is laying two thousand eggs a day, and that the full number of bees is forty thousand, or even more—though the bees are liable to so many accidents, and as the queen does not always lay to her full capacity, it is quite probable that this is about an average number—it will be seen that each day that a colony is without a queen there is a loss equal to about one-twentieth of the working force of the colony, and this is a compound loss, as the aggregate loss of any day is its special loss, augmented by the several losses of the previous days. Now, as queens are liable to die, to become impotent, and as the act of increasing colonies demands the absence of queens, unless the apiarist has extra ones at his command, it is imperative, would we secure the best results, to ever have at hand extra queens. So the young apiarist must early learn

HOW TO REAR QUEENS.

As queens may be needed by the last of May, preparations looking to the early rearing of queens must commence early. When preparing the colonies for winter the previous autumn, be sure to place some drone-comb somewhere near the centre of the colony that has given the best results the previous season. In March, and certainly by the first of April, see that all colonies have plenty of bee-bread. If necessary, place unbolted flour, rye or oats are best, in shallow troughs near the hives. It may be well to give the whole apiary the benefit of such feeding before the flowers yield pollen. Yet, I have found that here in Central Michigan, bees can usually gather pollen by the first week of April, which I think is as early as they should be allowed to fly, and, in fact, as early as they will fly with sufficient regularity to make it pay to feed

the meal. I much question, after some years of experiment, if it ever pays to give the bees a substitute for pollen.

The colony under consideration, should be given frames containing bee-bread which was stored the previous year. At the same time, March or April, commence stimulative feeding. If you have another colony equally good with the first, also give that the pollen, and commence giving it honey or syrup, but only worker-comb should be in the brood-chamber. This will prevent the close in-breeding which would of necessity occur if both queens and drones were reared in the same colony; and which, though regarded as deleterious in the breeding of all animals, should be practiced in case one single queen is of decided superiority to all others of the apiary.

Very likely in April, drone-eggs will be laid in drone-comb. I have had drones flying on the first of May. As soon as the drones commence to hatch out, remove the queen and all eggs and uncapped brood from some good, strong colony, and replace it with eggs or brood just hatched from the colony that is being fed, or if two equally good colonies have been stimulated, from the one in which no drone-comb was placed. The queen which has been removed may be used in making a new colony, in manner soon to be described under "dividing or increasing the number of colonies." This queenless colony will immediately commence forming queen-cells (Fig. 56). Sometimes these are formed to the number of fifteen or twenty, and they are started, too, in a full, vigorous colony, in fact, under the most favorable conditions. Cutting off edges of the comb, or cutting holes in the same where there are eggs or larvæ just hatched, will almost always insure the starting of queen-cells in such places. It will be noticed, too, that our queens are started from eggs or from larvæ but just hatched, as we have given the bees no other, and so are fed the royal pabulum from the first. Thus, we have met every possible requisite to secure the most superior queens. By removal of the queen we also secure a large number of cells, while if we waited for the bees to start the cells preparatory to natural swarming, in which case we secure the two desirable conditions named above, we shall probably fail to secure so many cells, and may have to wait longer than we can afford.

Even the apiarist who keeps black bees and desires no

others, or who has only pure Italians, will still find that it pays to practice this selection, for, as with the poultry fancier, or the breeder of our larger domestic animals, so, too, the apiarist is ever observing some individuals of marked superiority, and he who carefully selects such queens to breed from, will be the one whose profits will make him to rejoice, and whose apiary will be worthy of all commendation. As will be patent to all, by the above process we exercise a care in breeding which is not surpassed by the best breeders of horses and cattle, and which no wise apiarist will ever neglect.

After we have removed all the queen-cells, in manner soon to be described, we can again supply eggs, or newly-hatched larvæ—always from those queens which close observation has shown to be the most vigorous and prolific in the apiary—and thus keep the same queenless colony or colonies, engaged in starting queen-cells till we have all we desire. Yet we must not fail to keep this colony strong by the addition of *capped* brood, which we may take from any hive as most convenient. I have good reason to believe that queen-cells should not be started after the first of September, as I have observed that late queens are not only less prolific, but shorter lived. In nature, late queens are rarely produced, and if it is true that they are inferior, it might be explained in the fact, that the ovaries remain so long inactive. As queens that are long unmated are utterly worthless, so, too, mated queens long inactive are enfeebled.

In a week the cells are capped, and the apiarist is ready to form his

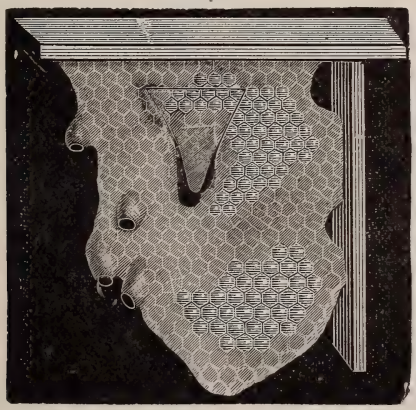
NUCLEI.

A nucleus is simply a miniature colony of bees—a hive and colony on a small scale, for the purpose of rearing and keeping queens. We want the queens, but can afford to each nucleus only a few bees. The nucleus hive, if we use frames not more than one foot square, need be nothing more than an ordinary hive, with chamber confined by a division-board to the capacity of three frames. If our frames are large, then it may be thought best to construct special nucleus hives. These are small hives, need not be more than six inches each way, that is, in length, breadth, and thickness, and made to

contain from four to six frames of corresponding size. These frames are filled with comb. I have for the last two or three years used the first named style of nucleus hive, and have found it advantageous to have a few long hives made, each to contain five chambers, while each chamber is entirely separate from the one next to it, is five inches wide, and is covered by a separate, close-fitting board, and the whole by a common cover. The entrance for the two end chambers is at the ends near the same side of the hive. The middle chamber has its entrance at the middle of the side near which are the end entrances, while the other two chambers open on the opposite side, as far apart as is possible. The outside might be painted different colors to correspond with the divisions, if thought necessary, especially on the side with two openings. Yet I have never taken this precaution, nor have I been troubled much by losing queens. They have almost invariably entered their own apartments when returning from their wedding tour. These hives I use to keep queens during the summer. Except the apiarist engages in queen-rearing extensively as a business, I doubt the propriety of building such special nucleus hives. The usual hives are good property to have in the apiary, will soon be needed, and may be economically used for all nuclei. In spring I make use of my hives which are prepared for prospective summer use, for my nuclei. Now go to different hives of the apiary, and take out three frames for each nucleus, at least one of which has brood, and so on, till there are as many nuclei prepared as you have queen-cells to dispose of. The bees should be left adhering to the frames of comb, only *we must be certain that the queen is not among them*, as this would take the queen from where she is most needed, and would lead to the sure destruction of one queen-cell. To be sure of this, never take such frames till *you have seen the queen*, that you may be *sure* she is left behind. I usually shake off into the nucleus the bees from one or two more frames, so that, even after the old bees have returned, there will still be a sufficient number of young bees left in the nucleus to keep the temperature at a proper height. If any desire the nuclei with smaller frames, these frames must of course be filled with comb, and then we can shake bees immediately into the nuclei, as given above,

till they shall have sufficient to preserve a proper temperature. In this case the queen-cell should be inserted just before the bees are added; in the other case, either before or after. Such special articles about the apiary are costly and inconvenient. I believe that I should use hives even with the largest frames for nuclei. In this case we should need to give more bees. To insert the queen-cell—for we are now to give one to each nucleus, so we can never form more nuclei than we have capped queen-cells—we first cut them out, commencing to cut on either side the base of the cell, at least one-half inch distant, *we must not in the least compress the cell*, then cutting up and out for two inches, then across opposite the cell. This leaves the cell attached to a wedge-

FIG. 56.



shaped piece of comb (Fig. 56), whose apex is next the cell. A similar cut in the middle frame of the nucleus, which in case of the regular frames is the one containing brood, will furnish an opening to receive the wedge containing the cell. The comb should also be cut away beneath (Fig. 56), so that the cell cannot be compressed. After all the nuclei have received their cells and bees, they have only to be set in a shady place and watched to see that sufficient bees remain. Should too many leave, give them more by removing the cover

and shaking a frame loaded with bees over the nucleus; keep the opening nearly closed, and cover the bees with a quilt. The main caution in all this *is to be sure not to get any old queen in a nucleus.* In two or three days the queens will hatch, and in a week longer will have become fertilized, and that, too, in case of the first queens, by selected drones, for as yet there are no other in the apiary, and the apiarist will possess from ten to thirty-five queens, which will prove his best stock in trade. I cannot over-estimate the advantage of ever having extra queens. To secure pure mating later, we must cut all drone-comb from inferior colonies, so that they shall rear no drones. If drone larvæ are in uncapped cells, they may be killed by sprinkling the comb with cold water. By giving the jet of water some force they may be washed out, or we may throw them out with the extractor, then use the comb for starters in our sections. By keeping empty frames, and empty cells in the nuclei, the bees may be kept active; yet with so few bees, one cannot expect very much from the nuclei. After cutting all the queen-cells from our old hive, we can again insert eggs, as above suggested, and obtain another lot of cells, or, if we have a sufficient number, we can leave a single queen-cell, and this colony will soon be the happy possessor of a queen, and just as flourishing as if the even tenor of its ways had not been disturbed.

SHALL WE CLIP THE QUEEN'S WING?

In the above operation, as in many other manipulations of the hive, we shall often gain sight of the queen, and can, if we desire, clip her wing, *if she has met the drone*, that in no case she shall lead the colony away to parts unknown. This does not injure the queen, as some have claimed. General Adair once stated that such treatment injured the queen, as it cut off some of the air-tubes, which view was approved by so excellent a naturalist as Dr. Packard. Yet we are sure that this is all a mistake. The air-tube and blood-vessel, as we have seen, go to the wings to carry nourishment to these members. With the wing goes the necessity of nourishment and the need of the tubes. As well say that the amputation of the human leg or arm would enfeeble the constitution, as it would cut off the supply of blood.

Many of our best apiarists have practiced this clipping of the queen's wings for years. Yet, these queens show no diminution of vigor; we should suppose they would be even more vigorous, as useless organs are always nourished at the expense of the organism, and if entirely useless, are seldom long continued by nature. The ants set us an example in this matter, as they bite the wings off their queens, after mating has transpired. They mean that the queen ant shall remain at home *nolens volens*, and why shall not we require the same of the queen bee? Were it not for the necessity of swarming in nature, we should doubtless have been anticipated in this matter by nature herself. Still, if the queen essays to go with a swarm, and if the apiarist is not at hand, she will very likely be lost, never regaining the hive; but in this case the bees will be saved, as *they will* return without fail. I always mean to be so watchful, keeping my hives shaded, giving ample room, and dividing or increasing, as to prevent natural swarming. But in lieu of such caution I see no objection to clipping the queen's wing, and would advise it.

Some apiarists clip one primary wing the first year, the secondary the second year, the other primary the the third, and if age of the queen permits, the remaining wing the fourth year. Yet, such data, with other matters of interest and importance, better be kept on a slate or card, and firmly attached to the hive, or else kept in a record, opposite the number of the hive. The time required to find the queen is sufficient argument against the "queen-wing record." It is not an argument against the once clipping of the queen's wings, for, in the nucleus hives, queens are readily found, and even in full colonies this is not very difficult, especially if we heed the dictates of interest and keep Italians. It will be best, even though we have to look up black queens, in full colonies. The loss of one good colony, or the vexatious trouble of separating two or three swarms which had clustered together, would soon vanquish this argument of time.

To clip the queen's wing, take hold of her wings with the left thumb and index finger—never grasp her body, *especially her abdomen*, as this will be very apt to injure her—raise her off the comb, then turn from the bees, place her gently on a board or any convenient object—even the knee will do—

she will thus stand on her feet, and not trouble by constantly passing her legs up by her wings, where they, too, would be in danger of being cut off. Now, take a small pair of scissors, and with the right hand open them, carefully pass one blade under one of the front wings, shut the blades, and all is over. Some apiarists complain that queens thus handled often receive a foreign scent, and are destroyed by the bees. I have clipped hundreds, and never lost one. I believe that the above method will not be open to this objection. Should the experience of any one prove to the contrary, the drawing on of a kid glove, or even the fingers of one, might remove the difficulty.

CHAPTER X.

INCREASE OF COLONIES.

No subject will be of more interest to the beginner, than that of increasing stocks. He has one or two, he desires as many score, or, if very aspiring, as many hundred, and if a Hetherington or a Harbison, as many thousand. This is a subject, too, that may well engage the thought and study of men of no inconsiderable experience. I believe that many veterans are not practicing the best methods in obtaining an increase of stocks.

Before proceeding to name the ways, or to detail methods, let me state and enforce, that it is always safest, and generally wisest, especially for the beginner, to be content with doubling, and certainly, with tripling, his number of colonies each season. Especially let all remember the motto, "Keep all colonies strong."

There are two ways to increase: The natural, known as swarming, already described under natural history of the bee; and artificial, improperly styled artificial swarming. This is also called, and very properly, too, "dividing."

SWARMING.

To prevent anxiety and constant watching, and to secure a more equable division of bees, and, as I know, more honey, it is better to provide against swarming entirely by use of means which will appear in the sequel. But as this requires some experience, and, as often, through neglect, either necessary or culpable, swarms may issue, every apiarist should be ever ready with both means and knowledge for immediate action. Of course, the hives were all made the previous winter, *and will never be wanting.* Neglect to provide hives before the swarming season, is convincing proof that the wrong pursuit has been chosen.

If, as we have advised, the queen has her wing clipped, the

matter becomes very simple, in fact, so much simplified that were there no other argument, this would be sufficient to recommend the practice of cutting the queen's wing. Now, if several swarms cluster together, we have not to separate them, they will separate of themselves and return to their old home. To migrate without the queen means death, and life is sweet even to bees, and is not to be willingly given up except for home and kindred. Neither has the apiarist to climb trees, to secure his bees from bushy trunks, from off the lattice-work or pickets of his fence, from the very top of a tall, slender, fragile fruit tree, and other most inconvenient places. Nor will he even be tempted to pay his money for patent hivers. He knows his bees will return to their old quarters, so he is not perturbed by the fear of loss, or plans to capture the unapproachable. It requires no effort "to possess his soul in patience." If he wishes no increase, he steps out, takes the queen by the remaining wings, as she emerges from the hive, soon after the bees commence their hilarious leave-taking, puts her in a cage, opens the hive, destroys, or, if he wishes to use them, cuts out the queen cells as already described (page 167), gives more room—either by adding boxes or taking out some of the frames of brood, as they may well be spared, places the cage enclosing the queen under the quilt, and leaves the bees to return at their pleasure. At night-fall the queen is liberated, and very likely the swarming fever squelched for the season.

If it is desired to hive the absconding swarm with a nucleus colony, exchange the places of the old hive containing the caged queen, and the nucleus, to which the swarm will then come. Remove queen-cells from the old hives as before, give some of the combs of brood to the nucleus, which is now a full colony, and empty frames, with comb or foundation starters, or, if you have them, empty combs to both, liberate the queen at night and all is well, and the apiarist rejoices in a new colony. If the apiarist has neglected to form nuclei, and so has no extra queens—*and this is a neglect*—and wishes to hive his swarm separately, he places his caged queen in an empty hive, with which he replaces the old hive till the bees return, then this new hive, with queen and bees, and,

still better, with a frame or two of brood, honey, etc., in the middle, which were taken from the old hive, is set on a new stand. The old hive, with all the queen-cells except the largest and finest one removed, is set back, so that the apiarist has forestalled the issue of after-swarms, except that other queen-cells are afterward started, which is not likely to happen. The old queen is liberated as before, and we are in the way of soon having two good colonies. Some apiarists cage the queen and let the bees return, then divide the colony as soon to be described.

Some extensive apiarists, who desire to prevent increase of colonies, cage the old queen, destroy cells, and exchange this hive—after taking out three or four frames of brood to strengthen nuclei—with one that recently swarmed. Thus a colony that recently sent out a swarm, but retained their queen, has probably, from the decrease of bees, loss of brood and removal of queen-cells, lost the swarming fever, and if we give them plenty of room and ventilation, they will accept the bees from a new swarm, and spend their future energies in storing honey. Southard and Ranney have been very successful in the practice of this method. If building of drone-comb in the empty frames which replaced the brood-frames removed, should vex the apiarist—Dr. Southard says they had no such trouble—it could be prevented by giving worker-foundation. If the swarming fever is not broken up, we shall only have to repeat the operation again in a few days.

HIVING SWARMS.

But in clipping wings, some queens may be omitted, or from taste, or other motive, some bee-keepers may not desire to "deform her royal highness." Then the apiarist must possess the means to save the would-be rovers. The means are good hives in readiness, some kind of a brush—a turkey-wing will do—and a bag or basket, with ever open top, which should be at least eighteen inches in diameter, and this receptacle so made that it may be attached to the end of a pole, and two such poles, one very long and the other of medium length.

Now, let us attend to the method: As soon as the cluster commences to form, place the hive on the ground near by, leaving the entrance widely open, which with our bottom-

board only requires that we draw the hive forward an inch or more over the alighting-board. As soon as the bees are fully clustered, we must manage as best we can to empty the whole cluster in front of the hive. As the bees are full of honey we need have little fear of stings. Should the bees be on a twig that could be sacrificed, this might be easily cut off with either a knife or saw, and so carefully as hardly to disturb the bees; then carry and shake the bees in front of the hive, when with joyful hum they will at once proceed to enter. If the twig must not be cut, shake them all into the basket, and empty before the hive. Should they be on a tree trunk, or a fence, then brush them with the wing into the basket, and proceed as before. If they are high up on a tree, take the pole and basket, and perhaps a ladder will also be necessary.

Always let ingenuity have its perfect work, not forgetting that the object to be gained is to get just as many of the bees as is possible on the alighting-board in front of the hive. Carelessness as to the quantity might involve the loss of the queen, which would be serious. The bees *will not* remain unless the queen enters the hive. Should a cluster form where it is impossible to brush or shake them off, they can be driven into a basket, or hive, by holding it above them and blowing smoke among them. As soon as they are nearly all in—a few may be flying around, but if the queen is in the new hive, they will go back to their old home, or find the new one—which Mr. Betsinger says they will always do, if it is not far removed—remove the hive to its permanent stand. All washes are more than useless. It is better that the hive be clean and pure. With such, if they are shaded, bees will generally be satisfied. But assurance will be made doubly sure by giving them a frame of brood, in all stages of growth, from the old hive. This may be inserted before the work of hiving is commenced. Mr. Betsinger thinks this will cause them to leave; but I think he will not be sustained by the experience of other apiarists. He certainly is not by mine. I never knew but one colony to leave uncapped brood; I have often known them to swarm out of an empty hive once or twice, and to be returned, after brood had been placed in the hive, when they accepted the changed conditions, and went at once

to work. This seems reasonable, too, in view of the attachment of bees for their nest of brood, as also from analogy. How eager the ant to convey her larvæ and pupæ—the so-called eggs—to a place of safety, when the nest has been invaded and danger threatens. Bees doubtless have the same desire to protect their young, and as they cannot carry them away to a new home, they remain to care for them in one that may not be quite to their taste.

If it is not desired to increase, the bees may be given to a colony which has previously swarmed, after removing from the latter all queen-cells, and adding to the room by giving boxes and removing some frames of brood to strengthen nuclei. This plan is practiced by Dr. Southard. We may even return the bees to their old home by taking the same precautionary measures, with a good hope that storing and not swarming will engage their attention in future ; and if we exchange their position with that of a nucleus, we shall be still more likely to succed in overcoming the desire to swarm ; though some seasons, usually when honey is being gathered each day for long intervals, but not in large quantities, the desire and determination of some colonies to swarm is implacable. Room, ventilation, changed position of hive, each and all will fail. Then we can do no better than to gratify the propensity, by giving the swarm a new home, and make an effort

TO PREVENT SECOND SWARMS.

As already stated, the wise apiarist will always have on hand extra queens. Now, if he does not desire to form nuclei (as already explained), and thus use these queen cells, he will at once cut them *all* out, and destroy them, and give the old colony a fertile queen. The method of introduction will be given hereafter, though in such cases there is very little danger incurred by giving them a queen at once. And by thoroughly smoking the bees, and sprinkling with sweetened water, and daubing the new queen with honey, we may be almost sure of success. If desired, the queen-cells can be used in forming nuclei, in manner before described. In this way we save our colony from being without a fertile queen for at least thirteen days, and that, too, in the very height of the honey season,

when time is money. If extra queens are wanting, we have only to look carefully through the old hive and remove all but one of the queen-cells. A little care will certainly make sure work, as, after swarming, the old hive is so thinned of bees, that only carelessness will overlook queen-cells in such a quest.

TO PREVENT SWARMING.

As yet we can only partly avert swarming. Mr. Quinby offered a large reward for a perfect non-swarming hive, and never had to make the payment. Mr. Hazen attempted it, and partially succeeded, by granting much space to the bees, so that they should not be impelled to vacate for lack of room. The Quinby hive already described, by the large capability of the brood-chamber, and ample opportunity for top and side-storing, looks to the same end. But we may safely say that a perfect non-swarming hive or system is not yet before the bee-keeping public. The best aids toward non-swarming are shade, ventilation, and roomy hives. But as we shall see in the sequel, much room in the brood-chamber, unless we work for extracted honey—by which means we may greatly repress the swarming fever—prevents our obtaining honey in a desirable style. If we add sections, unless the connection is quite free—in which case the queen is apt to enter them and greatly vex us—we must crowd some to send the bees into the sections. Such crowding is almost sure to lead to swarming. I have, by abrading the combs of capped honey in the brood-chamber, as suggested to me by Mr. M. M. Baldridge—causing the honey to run down from the combs—sent the bees crowding to the sections, and thus deferred or prevented swarming.

It is possible that by extracting freely when storing is very rapid, and then by rapidly feeding the extracted honey in the interims of honey secretion, we might prevent swarming, secure very rapid breeding, and still get our honey in sections. Too few experiments, to be at all decisive, have led me to look favorably in this direction.

The keeping of colonies queenless, in order to secure honey without increase, as practiced and advised by some even of our distinguished apiarists, seems to me a *very questionable*

practice, to which I cannot even lend my approval by so much as detailing the method. I would rather advise: keeping *a queen*, and the workers *all* at work *in every* hive, if possible, *all the time.*

HOW TO MULTIPLY COLONIES WITH THE BEST RESULTS.

We have already seen the evils of *natural* swarming, which, even though no stock is too much reduced in numbers, no colony lost by not receiving prompt attention, no Sunday quiet disturbed, and no time wasted in anxious watching, yet, at best, the old colony is queenless for about two weeks, *a state of things which no apiarist can or should afford.* The true policy then is to practice *artificial* swarming, as just described, where we save time by cutting the queen's wing, and save loss by permitting no colony to remain queenless, or still better to

DIVIDE.

This method will secure uniform colonies, will increase our number of colonies just to our liking, will save time, and that, too, when time is most valuable, and is in every respect safer and preferable to swarming. I have practiced dividing ever since I have kept bees, and *never without the best results.*

HOW TO DIVIDE.

By the process already described, we have secured a goodly number of fine queens, which will be in readiness at the needed time. Now, as soon as the white clover harvest is well commenced, early in June, we may commence operations. If we have but one colony to divide, it is well to wait till they become pretty populous, but not till they swarm. Take one of our waiting hives, which now holds a nucleus with fertile queen, and remove the same close along side the colony we wish to divide. This must only be done on warm days when the bees are active, and better be done, while the bees are busy, in the middle of the day. Remove the division-board of the new hive, and then remove five combs, well loaded with brood, and of course containing some honey, from the old colony, bees and all, to the new hive. Also take the remaining frames and shake the bees into the new hive. *Only be sure that the queen still remains in the old hive.* Fill both the

hives with empty frames—if the frames are filled with empty comb it will be still better, if not it will pay to give starters or full frames of foundation—and return the new hive to its former position. The old bees will return to the old colony, while the young ones will remain peaceably with the new queen. The old colony will now contain at least seven frames of brood, honey, etc., the old queen, and plenty of bees, so that they will work on as though naught had transpired, though perhaps moved to a little harder effort by the added space and five empty frames. The empty frames may be all placed at one end, or placed between the others, though not so as to divide brood.

The new colony will have eight frames of brood, comb, etc., three from the nucleus and five from the old colony, a young fertile queen, plenty of bees, those of the previous nucleus and the young bees from the old colony, and will work with a surprising vigor, often even eclipsing the old colony.

If the apiarist has several colonies, it is better to make the new colony from several old colonies, as follows: Take one frame of brood-comb from each of six old colonies, or two from each of three, and carry them, bees and all, and place with the nucleus. *Only, be sure that no queen is removed.* Fill all the hives with empty frames, as before. In this way we increase without in the least disturbing any of the colonies, and may add a colony every day or two, or perhaps several, depending on the size of our apiary, and can thus always, so my experience says, prevent swarming.

By taking only brood that is all capped, we can safely add one or two frames to each nucleus every week, without adding any bees, as there would be no danger of loss by chilling the brood. In this way, as we remove no bees, we have to spend no time in looking for the queen, and may build up our nuclei into full stocks, and keep back the swarming impulse with great facility.

These are unquestionably the best methods to divide, and so I will not complicate the subject by detailing others. The only objection that can be urged against them, and even this does not apply to the last, is that we must seek out the queen in each hive, or at least be sure that we do not remove her, though this is by no means so tedious if we have Italians, as

of course we all will. I might give other methods which would render unnecessary this caution, but they are to my mind inferior, and not to be recommended. If we proceed as above described, the bees will seldom prepare to swarm at all, and if they do they will be discovered in the act, by such frequent examinations, and the work may be cut short by at once dividing such colonies as first explained, and destroying their queen-cells, or, if desired, using them for forming new nuclei.

CHAPTER XI.

ITALIANS AND ITALIANIZING.

The history and description of Italians (see Frontis-plate) has already been considered (p. 41), so it only remains to discuss the subject in a practical light.

The superiority of the Italians seems at present a mooted question. A few among the able apiarists in our country take the ground that a thorough balancing of qualities will make as favorable a showing for the German, as for the Italian bees. I think, too, that the late Baron of Berlepsch held to the same view.

I think I am capable of acting as judge on this subject. I have never sold a half-dozen queens in my life, and so have not been unconsciously influenced by self interest. In fact, I have never had, if I except two years, any direct interest in bees at all, and all my work and experiments had only the promotion and spread of truth as the ultimatum.

Again, I have kept both blacks and Italians side by side, and carefully observed and noted results during eight different years of my experience. I have carefully collected data as to increase of brood, rapidity of storing, early and late habits in the day and season, kind of flowers visited, amiability, etc., and I believe that to say that they are not superior to black bees, is like saying that a Duchess among short-horns is in no wise superior to the lean, bony kine of Texas; or that our Essex and Berkshire swine are no whit better than the cadaverous lank breeds, with infinite noses, that, happily, are now so rare among us. The Italians are *far* superior to the German bees in many respects, and more—though I am acquainted with all the works on apiculture printed in our language, and have an extensive acquaintance with the leading apiarists of our country from Maine to California, yet I know of scarcely a baker's dozen that have had opportunity to form a correct

judgment, that do not give strong preference to the Italians. That these men are honest, is beyond question; that those who disagree with us are equally so, there is no doubt. The black bees are in some respects superior to the Italians, and if a bee-keeper's methods cause him to give these points undue importance, in forming his judgments, then his conclusions may be wrong. Faulty management, too, may lead to wrong conclusions.

The Italians certainly possess the following points of superiority:

First. They possess longer tongues (Fig. 20), and so can gather from flowers which are useless to the black bee. This point has already been sufficiently considered (p. 42). How much value hangs upon this structural peculiarity, I am unable to state. I have frequently seen Italians working on red clover. I never saw a black bee thus employed. It is easy to see that this might be, at certain times and certain seasons, a very material aid. How much of the superior storing qualities of the Italians is due to this lengthened ligula, I am unable to say.

Second. They are more active, and with the same opportunities will collect a good deal more honey. This is a matter of observation, which I have tested over and over again. Yet I will give the figures of another: Mr. Doolittle secured from two colonies, 309 lbs. and 301 lbs., respectively, of *box honey*, during the past season. These surprising figures, the best he could give, were from his best Italian stocks. Similar testimony comes from Klein and Dzierzon over the sea, and from hosts of our own apiarists.

Third. They work earlier and later. This is not only true of the day, but of the season. On cool days in spring, I have seen the dandelions swarming with Italians, while not a black bee was to be seen. On May 7th, 1877, I walked less than one-half a mile, and counted sixty-eight bees gathering from dandelions, yet only two were black bees. This might be considered an undesirable feature, as tending to spring dwindling. Yet, with the proper management, to be described while considering the subject of wintering, we think this no objection, but a great advantage.

Fourth. They are far better to protect their hives against

robbers. Robbers that attempt to plunder Italians of their hard-earned stores soon find that they have "dared to beard the lion in his den." This is so patent, that even the advocates of black bees are ready to concede it.

Fifth. They are almost proof against the ravages of the bee-moth's larvæ. This is also universally conceded.

Sixth. The queens are decidedly more prolific. This is probably in part due to the greater and more constant activity of the neuters. This is observable at all seasons, but very striking when building up in spring. No one who will take the pains to note the increase of brood will long remain in doubt on this point.

Seventh. They are less apt to breed in winter, when it is desirable to have the bees very quiet.

Eighth. The queen is more readily found, which is a great advantage. In the various manipulations of the apiary, it is frequently desirable to find the queen. In a full colony I would rather find three Italian queens than one black one. Where time is money, this becomes a matter of much importance.

Ninth. The bees are more disposed to adhere to the comb while being handled, which some might regard a doubtful compliment, though I consider it a desirable quality.

Tenth. They are, in my judgment, less liable to rob other bees. They will find honey when the blacks gather none, and the time for robbing is when there is no gathering. This may explain the above peculiarity.

Eleventh. And, in my estimation, a sufficient ground for preference, did it stand alone, the Italian bees are *far more amiable.* Years ago I got rid of my black bees, because they were so cross. Two years ago I got two or three colonies, that my students might see the difference, but to my regret; for, as we removed the honey in the autumn, they seemed perfectly furious, like demons, seeking whom they might devour, and this, too, despite the smoker, while the far more numerous Italians were safely handled, even without smoke. The experiment at least satisfied a large class of students as to superiority. Mr. Quinby speaks in his book of their being cross, and Captain Hetherington tells me, that if not much handled, they are more cross than the blacks. From my own

experience, I cannot understand this. Hybrids are even more cross than are the pure black bees, but otherwise are nearly as desirable as the pure Italians.

I have kept these two races side by side for years, I have studied them most carefully, and I feel sure that none of the above eleven points of excellence are too strongly stated.

The black bees will go into close boxes more readily than Italians, but if we use the sectional frames, and on other grounds we can afford to use no other, we shall find, with the more ample connection between the brood-chamber and sections, that even here, as Mr. Doolittle and many others have shown, the Italians still give the best returns.

I have some reasons to think that the blacks are more hardy, and have found many apiarists who agree with me. Yet, others of wide experience, think that there is no difference, while still others think the Italians more hardy.

The Italian bees are said to dwindle worse in spring, which, as they are more active, is quite probable. As I have never had a case of serious spring dwindling, I cannot speak from experience. If the bee-keeper prevents early spring flying, which is very detrimental to either black or Italian bees, this point will have no weight, even if well taken.

ALL SHOULD KEEP ONLY ITALIANS.

The advantages of the Italians, which have been considered thus fully, are more than sufficient to warrant the exclusion of all other bees from the apiary. Truly, no one need to be urged to a course, that adds to the ease, profit, and agreeableness of his vocation.

HOW TO ITALIANIZE.

From what has been already explained regarding the natural history of bees, it will be seen that all we have to do to change our bees, is to change our queens. Hence, to Italianize a colony, we have only to procure and introduce an Italian queen.

HOW TO INTRODUCE A QUEEN.

In dividing colonies, where we give our queen to a colony composed wholly of young bees, it is safe and easy to intro-

duce a queen in the manner explained in the section on artificial swarming. To introduce a queen to a colony composed of old bees more care is required. First, we should seek out the old queen and destroy her, then cage our Italian queen in a wire cage, which may be made by winding a strip of wire-cloth, three and one-half inches wide, and containing fifteen to twenty meshes to the inch, about the finger. Let it lap each way one-half inch, then cut it off. Ravel out the half inch on each side, and weave in the ends of the wires, forming a tube the size of the finger. We now have only to put the queen in the tube, and pinch the ends together, and the queen is caged. The cage containing the queen should be inserted between two adjacent combs containing honey, each of which will touch it. The queen can thus sip honey as she needs it. If we fear the queen may not be able to sip the honey through the meshes of the wire, we may dip a piece of clean sponge in honey and insert it in the upper end of the cage before we compress this end. This will furnish the queen with the needed food. In forty-eight hours we again open the hive, after a thorough smoking, also the cage, which is easily done by pressing the upper end, at right-angles to the direction of the pressure when we closed it. In doing this do not remove the cage. Now keep watch, and if, as the bees enter the cage or as the queen emerges, the bees attack her, secure her immediately and re-cage her for another forty-eight hours. I usually let some honey drip on the queen as soon as the cage is opened. Some think this renders the bees more amiable. I have introduced many queens in this manner, and have very rarely been unsuccessful.

Mr. Dadant stops the cage with a plug of wood, and when he goes to liberate the qeeen replaces the wooden stop with one of comb, and leaves the bees to liberate the queen by eating out the comb. I have tried this, but with no better success than I have had with the above method, while with this plan the queen is surely lost if the bees do not receive her kindly. Mr. Betsinger uses a larger cage, open at one end, which is pressed against the comb till the mouth of the cage reaches the middle of it. If I understand him, the queen is thus held by cage and comb till the bees liberate her. I have never tried this plan. When bees are not storing, especially

if robbers are abundant, it is more difficult to succeed, and at such time the utmost caution will occasionally fail of success if the bees are old.

A young queen, just emerging from a cell, can almost always be safely given at once to the colony, after destroying the old queen.

A queen cell is usually received with favor. If we adopt this course we must be careful to destroy all other queen-cells that may be formed; and if the one we supply is destroyed, wait seven days, then destroy all their queen-cells, and they are sure to accept a cell. But to save time I should always introduce a queen.

If we are to introduce an imported queen, or one of very great value, we might make a new colony, all of young bees, as already described. Smoke them well, sprinkle with sweetened water, daub the queen with honey, and introduce immediately. This method would involve really no risk. If the apiarist was still afraid, he could make assurance still more sure by taking combs of brood where the young bees were rapidly escaping from the cells; there would soon be enough young bees to cluster about the queen, and soon enough bees for a good colony. This plan would not be advisable except in warm weather, and care is also required to protect from robbers. The colony might be set in the cellar for a few days, in which case it would be safe even in early spring.

By having a colony thus Italianized in the fall, we may commence the next spring, and, as described in the section explaining the formation of artificial swarms, we may control our rearing of drones, queens, and all, and ere another autumn have only the beautiful, pure, amiable, and active Italians. I have done this several times, and with the most perfect satisfaction. I think by making this change in blood, we add certainly two dollars to the value of each colony, and I know of no other way to make money so easily and pleasantly.

TO GET OUR ITALIAN QUEEN.

Send to some reliable breeder, and ask for a queen worth at least five dollars. It is the mania now to rear and sell cheap queens. These are reared—must be reared—without care, and will, I fear, prove *very cheap*. It is a question, if

any more sure way could be devised to injure our stocks than the dollar queen business, which is now so popular. It is quite probable that much of the superiority of Italian bees is owing to the care and careful selection in breeding. Such careful selection in breeding, either with black or Italian bees, is what will augment the value of our apiaries.

The tendency of the dollar queen business is to disseminate the inferior queens, many of which will appear in every apiary. These should be killed, not sold. Yet, many an apiarist will think even the poorest queens are worth a dollar. My friend, Mrs. Baker, bought a dollar "Albino" queen last season which was not worth a cent. Yet it cost only a dollar, and, of course, no satisfaction could be secured or even asked for. I think it behooves apiarists to think of this matter, and see if dollar queens are not very dear. I have thrown away three dollars on them, and have concluded to pay more and buy cheaper in future.

I believe our breeders should be encouraged to give us the best; to study the art of breeding, and never send out an inferior queen. In this way we may hope to keep up the character of our apiaries, and the reputation of Italians. Else we are safer under the old system where "natural selection" retained the best, by the "survival of the fittest."

REARING AND SHIPPING QUEENS.

I have already explained the matter of queen-rearing. After many inquiries, and some experience, I much doubt if any apiarist can afford to rear queens, such as apiarists wish to buy, for less than four or five dollars. Only the best should be sold, and no pains should be spared by the breeder to secure such queens.

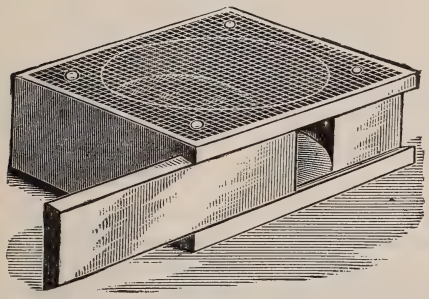
TO SHIP QUEENS.

This is a very simple matter. We have only to secure a square block two inches each way, and one and a half inches deep—a hole bored into a two-inch plank to within a quarter of an inch of the bottom serves admirably. In this should be inserted a piece of capped honey, which has been *entirely* cleaned by bees. Bees will speedily perform this work, if the comb containing the honey is placed on the

alighting-board. This must be fastened into the shipping-box, which is easily done, by pinning it with a slender wooden pin, which passes through holes previously bored in the box. We now cover the open chamber with fine wire-cloth, put in our queen and fifteen or twenty bees, and she is ready to ship. *Any uncapped honey to daub the queen is almost sure to prove fatal.*

Mr. A. I. Root furnishes a cage already provisioned with sugar (Fig. 57), which is very neat and safe. I have received

FIG. 57.



queens from Tennessee, which were fed exclusively on candy, and came in excellent condition.

TO MOVE COLONIES.

Should we desire to purchase Italian or other colonies, the only requisites to safe transport are: A wire-cloth cover for ventilation, secure fastening of the frames so they cannot possibly move, and combs old enough so that they shall not break down and fall out. I should never advise moving bees in winter, though it has often been done with entire safety. I should wish the bees to have a flight very soon after such disturbance.

CHAPTER XII.

EXTRACTING, AND THE EXTRACTOR.

The brood-chamber is often so filled with honey that the queen has no room to lay her eggs, especially if there is any neglect to give other room for storing. Honey, too, in brood-combs is unsalable, because the combs are dark, and the size undesirable. Comb, too, is very valuable, and should never be taken from the bees, except when desired to render the honey more marketable. Hence, the apiarist finds a very efficient auxiliary in the

HONEY EXTRACTOR.

No doubt some have expected and claimed too much for this machine. It is equally true, that some have blundered quite as seriously in an opposite direction. For, since Mr. Langstroth gave the movable frame to the world, the apiarist has not been so deeply indebted to any inventor as to him who gave us the Mell Extractor, Herr von Hruschka, of Germany. Even if there was no sale for extracted honey—aye, more, even if it must be thrown away, which will never be necessary, as it may always be fed to the bees with profit, even then I would pronounce the extractor an invaluable aid to every bee-keeper.

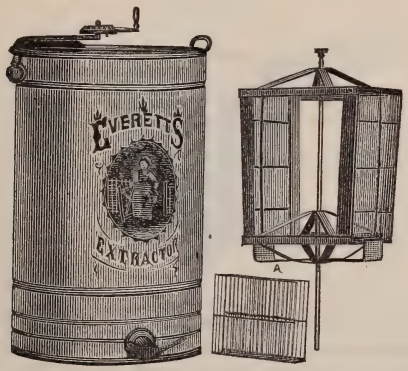
The principle which makes this machine effective is that of centrifugal force, and it was suggested to Major von Hruschka, by noticing that a piece of comb which was twirled by his boy at the end of a string, was emptied of its honey. Herr von Hruschka's machine was essentially like those now so common, though in lightness and convenience there has been a marked improvement. His machine consisted of a wooden tub, with a vertical axle in the centre, which revolved in a socket fastened to the bottom of the vessel, while from the top of the tub, fastenings extended to the axle, which projected

for a distance above. The axle was thus held exactly in the centre of the tub. Attached to the axle was a frame or rack to hold the comb, whose outer face rested against a wire-cloth. The axle with its attached frame, which latter held the uncapped comb, was made to revolve by rapidly unwinding a string, which had been previously wound about the top of the axle, after the style of top-spinning. Replace the wooden tub with one of tin, and the string with gearing, and it will be seen that we have essentially the neat extractor of to-day. As the machine is of foreign invention, it is not covered by a patent, and may be made by any one without let or hindrance. A good machine may be bought for eight dollars.

WHAT STYLE TO BUY.

The machine should be as light as is consistent with strength. It is best that the can be stationary, and that

FIG. 58.

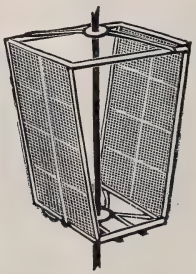


only a light frame be made to revolve with the comb. It is desirable that the machine should run with gearing, not only for ease, but also to insure or allow an even motion, so that we need not throw even drone larvæ from the brood-cells. The arrangement for exit of the honey should permit a speedy and perfect shut-off. A molasses gate is excellent to serve for a faucet. I should also prefer that the can hold consid-

erable honey—thirty or forty pounds—before it would be necessary to let the honey flow from it.

In case of small frames, like the ones I have described as most desirable to my mind, I should prefer that the rack might hold four frames. Mr. O. J. Hetherington has found that winding the rack with fine wire, serves better than wire-cloth to resist the combs, while permitting the honey to pass. The rack should set so low in the can that no honey would ever be thrown over the top to daub the person using the machine. I think that a wire basket, with a tin bottom, and made to hook on to the comb-rack (Fig. 58, *a*, *a*) which will hold pieces of comb not in frames, a desirable improvement to an extractor. Such baskets are appended to the admirable extractor (Fig. 58) made by Mr. B. O. Everett, of Toledo, Ohio, which, though essentially like the extractor of Mr. A. I. Root, has substantial improvements, and is the cheapest, and I think the best extractor, that I have used or seen.

FIG. 59.



I have tried machines where the sides of the rack (Fig. 59) inclined down and in, for the purpose of holding pieces of comb, but found them unsatisfactory. The combs would not be sustained. Yet, if the frames were long and narrow, so that the end of the frame would have to rest on the bottom of the rack, instead of hanging as it does in the hive, such an incline might be of use to prevent the top of the frame from falling in, before we commence to turn the machine.

The inside, if metal, which is lighter and to be preferred to wood, as it does not sour or absorb the honey, should be

either of tin or galvanized iron, so as not to rust. A cover to protect the honey from dust, when not in use, is very desirable. The cloth cover, gathered around the edge by a rubber, as made by Mr. A. I. Root, is excellent for this purpose.

As no capped honey could be extracted, it is necessary to extract honey before it is capped, or else uncap it, which is

FIG. 60.



done by shaving off the thin caps. To do this, nothing is better than a very thin case-knife. Mr. Heddon, whose experience is very large, agrees with me in the above opinion. The knives (Fig. 60) should be thin, of the best steel, and

FIG. 61.



if not very thin, it is perhaps desirable to have a curved point (Fig. 61), though this is not at all essential.

USE OF THE EXTRACTOR.

Although some of our most experienced apiarists say nay, it is nevertheless a fact, that the queen often remains idle, or extrudes her eggs only to be lost, simply because there are no empty cells. The honey yield is so great that the workers occupy every available space, and sometimes even they become unwilling idlers, simply because of necessity. Seldom a year has passed but that I have noticed some of my most prolific queens thus checked in duty. It is probable that just the proper arrangement and best management of frames for surplus would make such occasions rare; yet, I have seen the brood-chamber in two-story hives, with common frames above —the very best arrangement to promote storing above the brood-chamber—so crowded as to force the queen either to idle-

ness or to egg-laying in the upper frames. This fact, as also the redundant brood, and excessive storing that follows upon extracting from the brood-chamber, makes me emphatic on this point, notwithstanding the fact that some men of wide experience and great intelligence, think me wrong.

The extractor, too, enables the apiarist to secure honey—extracted honey—in poor seasons, when he could get very little, if any, in sections or boxes.

By use, too, of the extractor, at any time or season, the apiarist can secure nearly if not quite double the amount of honey, that he could get in combs.

The extractor enables us to remove uncapped honey in the fall, which, if left in the hive, may cause disease and death.

By use of the extractor, too, we can throw the honey from our surplus brood-combs in the fall, and thus have a salable article, and have the empty combs, which are invaluable for use the next spring. We now have in our apiary one hundred and fifty such empty combs.

If the revolving racks of the extractor have a wire basket attachment, at the bottom as I have suggested, the uncapped sections can be emptied in the fall, if desired, and pieces of drone-comb cut from the brood-chamber, which are so admirable for starters in the sections, can be emptied of their honey at any season.

By use of the extractor, we can furnish at one-half the price we must ask for comb-honey, an article which is equal, if not superior, to the best comb-honey, and which, were it not for appearance alone, would soon drive the latter from the market.

WHEN TO USE THE EXTRACTOR.

If extracted honey can be sold for fifteen, or even twelve cents, the extractor may be used profitably the summer through; otherwise use it sufficiently often that there may always be empty worker-cells in the brood-chamber.

It is often required with us during the three great honey harvests—the white clover, basswood, and that of fall flowers. I have always extracted the honey at such times before it was capped, in fact, as fast as the cells were filled, and never yet found it so thin, if I may except one case of basswood honey, that it was not agreeable and wholesome.

In the case excepted, the season was very wet, but by allowing the honey to stand in a warm room, it soon became thick, and of most pleasing flavor.

I make the following recommendation with some fear, as so many are of contrary opinion; yet, I am so sanguine, and I have had some years of experience, that I ask all to test the matter, which I believe will lead to its practice. Extract so often as to prevent the work of uncapping. If the honey is thin, let it stand for some days or weeks in a warm, dry room, or if you wish to sell at once, apply a mild heat.

If the honey granulates, it can be reduced to the fluid state with no injury, by heating, though the temperature should never rise above 200° F. This can best be done by placing the vessel containing the honey in another containing water, though if the second vessel be set on a stove, a tin basin or pieces of wood should prevent the honey vessel from touching the bottom, else the honey would burn. As before stated, the best honey is almost sure to crystallize, but it may be prevented by keeping it in a temperature which is constantly above 80° F. If canned honey is set on top a furnace in which a fire is kept burning, it will remain liquid indefinitely.

To render the honey free from small pieces of comb, or other impurities, it should either be passed through a cloth or wire sieve—I purposely refrain from the use of the word strainer, as we should neither use the word strained, nor allow it to be used, in connection with extracted honey—or else draw it off into a barrel, with a faucet or molasses gate near the lower end, and after all particles of solid matter have risen to the top, draw off the clear honey from the bottom. In case of very thick honey, this method is not so satisfactory as the first. I hardly need say that honey, when heated, is thinner, and will of course pass more readily through common toweling or fine wire-cloth.

Never allow the queen to be forced to idleness for want of empty cells. Extract all uncapped honey in the fall, and the honey from all the brood-combs not needed for winter. The honey, too, should be thrown from pieces of drone-comb which are cut from the brood-frames, and from the uncapped comb in sections at the close of the season.

HOW TO EXTRACT.

The apiarist should possess one or two light boxes, of sufficient size to hold all the frames from a single hive. These should have convenient handles, and a close-fitting cover, which will slide easily either way. These will be more easily used if they rest on legs, which will raise their tops say three feet from the ground. Now, go to two or three colonies, take enough combs, and of the right kind for a colony. The bees may be shaken off or brushed off with a large feather. If the bees are troublesome, close the box as soon as each comb is placed inside. Extract the honey from these, using care not to turn so hard as to throw out the brood. If necessary, with a thin knife pare off the caps, and after throwing the honey from one side, turn the comb around, and extract it from the other. If combs are of very different weights, it will be better for the extractor, to use those of nearly equal weights on opposite sides, as the strain will be much less. Now take these combs to another colony, whose combs shall be replaced by them. Then close the hive, extract this second set of combs, and thus proceed till the honey has all been extracted. At the close, the one or two colonies from which the first combs were taken shall receive pay from the last set extracted, and thus, with much saving of time, little disturbance of bees, and the least invitation to robbing, in case there is no gathering, we have gone rapidly through the apiary.

CHAPTER XIII.

HANDLING BEES.

But some one asks the question, shall we not receive those merciless stings, or be introduced to what "Josh" calls the "business end of the bee?" Perhaps there is no more causeless, or more common dread, in existence, than this of bees' stings. When bees are gathering, they will never sting unless provoked. When at the hives—especially if Italians—they will rarely make an attack. The common belief, too, that some persons are more liable to attack than others, is, I think, put too strong. With the best opportunity to judge, with our hundreds of students, I think I may safely say that one is almost always as liable to attack as another, except that he is more quiet, or does not greet the usually amiable passer-by, with those terrific thrusts, which would vanquish even a practiced pugilist. Occasionally a person *may* have a peculiar odor about his person that angers bees and invites their darting tilts, with drawn swords, venom-tipped, yet, though I take my large classes each season, at frequent intervals, to see and handle the bees, each for himself, I still await the first proof of the fact, that one person is more liable to be stung than another, providing each carries himself with that composed and dignified bearing, that is so pleasing to the bees. True, some people, filled with dread, and the belief that bees regard them with special hate and malice, are so ready for the battle, that they commence the strife with nervous head-shakes and beating of the air, and thus force the bees to battle, *nolens volens*. I believe that only such are regarded with special aversion by the bees. Hence, I believe that *no one* need be stung.

Bees should never be jarred, nor irritated by quick motions. Those with nervous temperaments—and I plead very guilty on this point—need not give up, but at first better protect

their faces, and perhaps even their hands, till time and experience show them that fear is vain; then they will divest themselves of all such useless encumbrances. Bees are more cross when they are gathering no honey, and at such times, black bees and hybrids, especially, are so irritable that even the experienced apiarist will wish a veil.

THE BEST BEE-VEIL.

This should be made of black tarlatan, sewed up like a bag, a half yard long, without top or bottom, and with a diameter of the rim of a common straw-hat. Gather the top with braid, so that it will just slip over the crown of the hat—else, sew it to the edge of the rim of some cheap, cool hat, in fact, I prefer this style—and gather the bottom with rubber cord or rubber tape, so that it may be drawn over the hat rim, and then over the head, as we adjust the hat.

Some prefer to dispense with the rubber cord at the bottom (Fig. 62), and have the veil long so as to be gathered in by the coat or dress. If the black tarlatan troubles by coloring

FIG. 62.



the shirt or collar, the lower part may be made of white netting. When in use, the rubber cord draws the lower part close about the neck, or the lower part tucks within the coat or vest (Fig. 62), and we are safe. This kind of a veil is

cool, does not impede vision at all, and can be made by any woman at a cost of less than twenty cents. Common buck-skin or sheep-skin gloves can be used, as it will scarcely pay to get special gloves for the purpose, for the most timid person—I speak from experience—will soon consider gloves an unnecessary nuisance.

Special rubber gloves are sold by those who keep on hand apiarian supplies.

Some apiarists think that dark clothing is specially obnoxious to bees.

For ladies, my friend, Mrs. Baker, recommends a dress which, by use of the rubber skirt-lift or other device, can be instantly raised or lowered. This will be convenient in the apiary, and tidy anywhere. The Gabrielle style is preferred, and of a length just to reach the floor. It should be belted at the waist, and cut down from the neck in front, one-third the length of the waist, to permit the tucking in of the veil. The under-waist should fasten close about the neck. The sleeves should be quite long to allow free use of the arms, and gathered in with a rubber cord at the wrist, which will hug the rubber gauntlets or arm, and prevent bees from crawling up the sleeves. The pantalets should be straight and full, and should also have the rubber cord in the hem to draw them close about the top of the shoes.

Mrs. Baker also places great stress on the wet "head-cap," which she believes the men even would find a great comfort. This is a simple, close-fitting cap, made of two thicknesses of coarse toweling. The head is wet with cold water, and the cap wet in the same, wrung out, and placed on the head.

Mrs. Baker would have the dress neat and clean, and so trimmed that the lady apiarist would ever be ready to greet her brother or sister apiarists. In such a dress there is no danger of stings, and with it there is that show of neatness and taste, without which no pursuit could attract the attention, or at least the patronage, of our refined women.

TO QUIET BEES.

In harvest seasons, the bees, especially if Italians, can almost always be handled without their showing resentment. But at other times, and whenever they object to necessary

familiarity, we have only to cause them to fill with honey to render them harmless, unless we pinch them. This can be done by closing the hive so that the bees cannot get out, and then rapping on the hive for four or five minutes. Those within will fill with honey, those without will be tamed by surprise, and all will be quiet. Sprinkling the bees with sweetened water will also tend to render them amiable, and will make them more ready to unite, to receive a queen, and less apt to sting. Still another method, more convenient, is to smoke the bees. A little smoke blown among the bees will scarcely ever fail to quiet them, though I have known black bees in autumn, to be very slow to yield. Dry cotton cloth, closely wound and sewed or tied, or better, pieces of dry, rotten wood, are excellent for the purpose of smoking. These are easily handled, and will burn for a long time. But best of all is a

BELLOWS-SMOKER.

This is a tin tube attached to a bellows. Cloth or rotten wood can be burned in the tube, and will remain burning a long time. The smoke can be directed at pleasure, the bellows easily worked, and the smoker used without any disagreeable effects or danger from fire. It can be got from any dealer in bee apparatus, and only costs from $1.25 to $2.00. I most heartily recommend it to all.

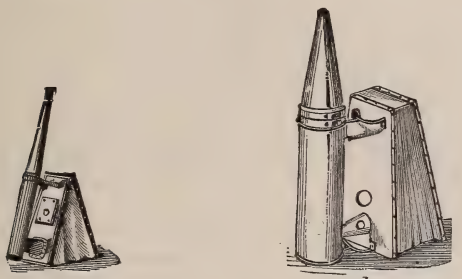
There are two smokers in use, which I have found very valuable, and both of which are worthy of recommendation.

THE QUINBY SMOKER.

This smoker (Fig. 63, *a*) was a gift to bee-keepers by the late Mr. Quinby, and not patented; though I supposed it was, and so stated in a former edition of this work. Though a similar device had been previously used in Europe, without doubt Mr. Quinby was not aware of the fact, and as he was the person to bring it to the notice of bee-keepers, and to make it so perfect as to challenge the attention and win the favor of apiarists *instanter*, he is certainly worthy of great praise, and deserving of hearty gratitude. This smoker, until a better one appeared, was a very valuable and desirable instrument. Its faults were, lack of strength, too small a

fire-tube, too little draft when not in use, so that the fire would go out, and too great liability to fall over on the side, when the fire was sure to be extinguished. Many of these

FIG. 63.



a *b*

defects, however, have been corrected, and other improvements made in a new smoker, called the Improved Quinby (Fig. 63. *b*).

THE BINGHAM SMOKER.

This smoker (Fig. 64) not only meets all the requirements, which are wanting in the old Quinby smoker, but shows by its

FIG. 64.



whole construction, that it has not only as a whole, but in every part, been subject to the severest test, and the closest thought and study.

At first sight this seems an improved copy of Mr. Quinby's smoker, and so I first thought, though I only saw it in Mr. Bingham's hand at a Convention. I have since used it, examined it in every part, and have to say that it is not a Quinby smoker. The bellows, the valve, the cut-off, and even the form, are all peculiar. The special point to be commended, and, I suppose, the only one patentable, is the cut-off between the bellows and fire-tube, so that the fire seldom goes out, while even hard-wood, as suggested by the inventor, forms an excellent and ever-ready fuel. The valve for the entrance of air to the bellows, permits rapid work, the spring is of the best clock-spring material, the leather perfect, not split sheep-skin, while the whole construction of the bellows, and the plan of the fire-screen and cut-off draft, show much thought and ingenuity. I am thus full in this description, that I may not only benefit my readers, all of whom will want a smoker, but also out of gratitude to Mr. Bingham, who has conferred such a favor on American apiarists. There are three sizes, which may be bought for $1.25, $1.60 and $2.00, respectively, including postage.

Mr. Bingham, to protect himself, and preserve the quality of his invention, has procured a patent. This, providing he has only patented his own invention, is certainly his right, which I think honesty requires us all to respect. Like Mr. Langstroth, he has given us a valuable instrument, unlike Mr. Langstroth, he should be granted a reward for his gift.

Brother apiarists, let us cease this unjust clamor against patents and patentees. If a man procures a patent on a worthless thing, let him alone, and where is the damage? If a man procures a patent on a valuable and desirable invention, then buy it, or pay for the right to make it, and thus keep the Eighth and Tenth Commandments (Exodus, 20th chap., 8th and 10th verses). Let us never buy an article unless we know it is valuable and desirable for us, no matter how stoutly importuned; but for honesty's sake, and that we may encourage more inventions, let us respect a man's patent as we would any other property. If we are in doubt as to the correctness of some person's claim, let us not be forced to pay a bonus, but first write to some candid editor or other authority, and if we find a man has a right to the article, then

pay as we would any other debt. I should be very suspicious of any man's honesty who was not willing to respect such rights.

TO SMOKE BEES.

Approach the hive, blow a little smoke in at the entrance, then open from above, and blow in smoke as required. If at any time the bees seem irritable, a few puffs from the smoker will subdue them. Thus, any person may handle his bees with perfect freedom and safety. If at any time the fire-chamber or escape-pipe become filled with soot, they can easily be cleaned by revolving an iron or hard-wood stick inside them.

TO CURE STINGS.

In case a person is stung, he should step back a little for a moment, as the pungent odor of the venom is likely to anger the bees and induce further stinging. The sting should be withdrawn, and if the pain is such as to prove troublesome, apply a little ammonia. The venom is an acid, and is neutralized by the alkali. Pressing over the sting with the barrel of a watch-key is also said to be of some use in staying the progress of the poison in the circulation of the blood. In case horses are badly stung, as sometimes happens, they should be taken as speedily as possible into a barn (a man, too, may escape angry bees by entering a building), where the bees will seldom follow, then wash the horses in soda water, and cover with blankets wet in cold water.

THE SWEAT THEORY.

It is often stated that sweaty horses and people are obnoxious to the bees, and hence, almost sure targets for their barbed arrows. In warm weather I perspire most profusely, yet am scarcely ever stung, since I have learned to control my nerves. I once kept my bees in the front yard—they looked beautiful on the green lawn—within two rods of a main thoroughfare, and not infrequently let my horse, covered with sweat upon my return from a drive, crop the grass, while cooling off, right in the same yard. Of course, there was some danger, but I never knew my horse to get stung. Why, then, the theory? May not the more frequent stings be consequent

upon the warm, nervous condition of the individual? The man is more ready to strike and jerk, the horse to stamp and switch. The switching of the horse's tail, like the whisker trap of a full beard, will anger even a good-natured bee. I should dread the motions more than the sweat, though it may be true that there is a peculiarity in the odor from either the sensible or insensible perspiration of some persons, that angers the bees and provokes the use of their terrible weapons.

CHAPTER XIV.

COMB FOUNDATION.

Every apiarist of experience knows that empty combs in frames, comb-guides in the sections, to tempt the bees and to insure the proper position of the full combs, in fact, combs of almost any kind or shape, are of great importance. So every skillful apiarist is very careful to save all drone-comb that is cut out of the brood-chamber—where it is worse than useless, as it brings with it myriads of those useless, gormands, the drones—to kill the eggs, remove the brood, or extract the honey, and to transfer it to the sections. He is equally careful to keep all his worker-comb, so long as the cells are of proper size to domicile full-sized larvæ, and never to sell any comb, or even comb-honey, unless a much greater price makes it desirable.

No wonder, then, if comb is so desirable, that German thought and Yankee ingenuity have devised means of giving the bees at least a start in this important, yet expensive work

FIG. 65.



of comb-building, and hence the origin of another great aid to the apiarist—comb foundation (Fig. 65).

HISTORY.

For more than twenty years the Germans have used impressed sheets of wax as a foundation for comb, as it was first made by Herr Mehring, in 1857. These sheets are four or five times as thick as the partition at the centre of natural comb,

which is very thin, only 1-180 of an inch thick. This is pressed between metal plates so accurately formed that the wax receives rhomboidal impressions which are a *fac simile* of the basal wall or partition between the opposite cells of natural comb. The thickness of this sheet is no objection, as it is found that the bees almost always thin it down to the natural thickness, and probably use the shavings to form the walls. The above, I think, is the extent to which the Germans have carried the work. They used plates, not rollers, to stamp the wax, and were content with the mere base, without any start whatever of the cell-wall, and here we come to

AMERICAN FOUNDATION.

Mr. Wagner secured a patent on foundation in 1861, but as the article was already in use in Germany, the patent was, as we understand, of no legal value, and certainly as it did nothing to bring this desirable article into use, it had no virtual value.

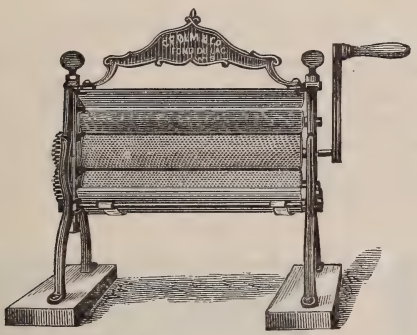
In 1868, the King brothers, of New York, made, and secured a patent on the first rollers. These were stamped like the German plates, and were mere wheels, being only one and a half inches wide. This was used to stamp the wax that was run upon wood, solely for guides in the brood-chamber. This machine fell dead, as it gave no impetus to the sale and general use of foundation.

In 1874, Mr. Frederick Weiss, a poor German, invented the machine which brought the foundation into general use. His machine had lengthened rollers—they being six inches long—and shallow grooves between the pyramidal projections, so that there was a very shallow cell raised from the basal impression as left by the German plates. This was the machine on which was made the beautiful and practical foundation sent out by "John Long," in 1874 and 1875, and which proved to the American apiarists that foundation machines, and foundation, too, were to be a success. I used some of this early foundation, and have been no more successful with that made by the machines of to-day. To Frederick Weiss, then, are Americans and the world indebted for this invaluable aid to the apiarist. Yet, the poor old man has, I fear, received very meager profits from this great invention, while some

writers ignore his services entirely, not granting him the poor meed of the honor. Since that time many machines have been made, without even a thank you, as I believe, to this old man, Weiss. Does not this show that patents, or something—a higher morality, if you please—is necessary, that men may secure justice? True, faulty foundation, and faulty machines were already in use, but it was the inventive skill of Mr. Weiss that made foundation cheap and excellent, and thus popularized it with the American apiarists.

These Weiss machines turn out the comb-foundation not only of exquisite mold, but with such rapidity that it can be made cheap and practicable. Heretofore these machines

FIG. 66.



have been sold at an enormous profit. Last November, 1877, I expostulated with one of the manufacturers of American machines, because of the high price, saying, as I looked at one of the machines: These ought to be sold for thirty or forty dollars, instead of one hundred dollars. He replied that such machines—with rollers, not plates—that gave the foundation the exact figure of natural comb, were only made, he thought, by the person who made his machines, and thus convinced me that said person should be rewarded, *amply rewarded*, for his invention. But as I have since learned that this is only the Weiss machine, and does no more perfect work, I now think Mr. Weiss should receive the super-extra profits. Even with machines at one hundred dollars, founda-

tion was profitable, as I with many others have found. But with the present price—forty dollars, which I think, judging from the simplicity of the machine, advertised at that price (Fig. 66), must be reduced still lower—we can hardly conceive what an immense business this is soon to become.

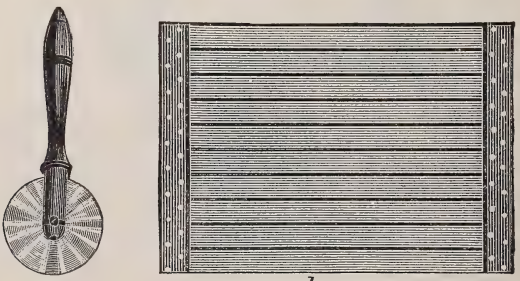
HOW FOUNDATION IS MADE.

The process of making the foundation is very simple. Thin sheets of wax, as thin as is consistent with strength, are simply passed between the rollers, which are so made as to stamp worker or drone foundation, as may be desired. The rollers are well covered with starch-water to secure against adhesion. Two men can roll out about four hundred pounds per day.

TO SECURE THE WAX SHEETS.

To make the thin sheets of wax, Mr. A. I. Root takes sheets or plates of galvanized iron with a wooden handle. These are cooled by dipping in ice-water, and then by dipping two, or three times if the wax is very hot, in the melted wax, which is maintained at the proper temperature by keeping it in a double-walled vessel, with hot water in the outer chamber.

FIG. 67.



a *b*

Such a boiler, too, prevents burning of the wax, which would ruin it, while it is being melted. After dipping the plates in the wax, they are again dipped, when dripping has ceased, into the cold water, after which the sheets of wax are cleaved off, the plates brushed, wiped, cooled, and dipped again. The

boiler used in melting the wax has the gate with a fine wire sieve attached near the top, so that the wax as it is drawn off into the second boiler, will be thoroughly cleansed. Mr. Root states that two men and a boy will thus make four hundred pounds of wax sheets in a day.

Others use wooden plates on which to mold the sheets, while the Hetherington brothers prefer, and are very successful with a wooden cylinder, which is made to revolve in the melted wax, and is so hinged, that it can be speedily raised above or lowered into the liquid.

For cutting foundation, nothing is so admirable as the Carlin cutter (Fig. 67, *a*), which is like the wheel glass-cutters sold in the shops, except that a larger wheel of tin takes the place of the one of hardened steel. Mr. A. I. Root has suggested a grooved board (Fig. 67, *b*) to go with the above, the distance between the grooves being equal to the desired width of the strips of comb foundation to be cut.

USE OF FOUNDATION.

I have used foundation, as have many other more extensive apiarists, with perfect success in the section-boxes. The bees have so thinned it that even epicures could not tell comb-honey with such foundation, from that wholly made by the bees. Yet, I forbear recommending it for such use. When such men as Hetherington, Moore, Ellwood, and L. C. Root, protest against a course, it is well to pause before we adopt it; so, while I have used foundation, I think with some small advantage in sections and boxes for three years, I shall still pronounce against it.

It will not be well to have the word artificial hitched on to our comb-honey. I think it exceedingly wise to maintain inviolate in the public mind the idea that comb-honey is *par excellence*, a natural product. And as Captain Hetherington aptly suggests, this argument is all the more weighty, in view of the filthy condition of much of our commercial bees-wax.

Again, our bees may not always thin the foundation, and we risk our reputation in selling it in comb-honey, and an unquestioned reputation is too valuable to be endangered in this way, especially as in these days of adulteration, we may not

know how much paraffine, etc., there is in our foundation, unless we make it ourselves.

Lastly, there is no great advantage in its use in the sections, as drone-comb is better, and with caution and care this can be secured in ample quantities to furnish very generous starters for all our sections.

If any one should still be disposed to make such use of foundation, they should only purchase of very reliable parties, that they may be sure to use only such wax as is genuine, *yellow*, clean, and *certainly unmixed with paraffine*, or any of the commercial products which were first used to adulterate the wax. *Only pure, clean, unbleached wax should be used in making foundation.* We should be *very careful* not to put on the market any comb-honey where the foundation had not been properly thinned by the bees. Perhaps a very fine needle would enable one to determine this point without injury to the honey.

But the most promising use of foundation, to which there can be no objection, is in the brood-chamber. It is astonishing to see how rapidly the bees will extend the cells, and how readily the queen will stock them with eggs if of the right size, five cells to the inch. *The foundation should always be the right size either for worker or drone-comb.* Of course the latter size would never be used in the brood-chamber. The advantage of foundation is, first, to insure worker-comb, and thus worker-brood, and second, to furnish wax, so that the bees may be free to gather honey. We proved in our apiary the past two seasons, that by use of foundation, and a little care in pruning out the drone-comb, we could limit or even exclude drones from our hives, and we have but to examine the capacious and constantly crowded stomachs of these idlers, to appreciate the advantage of such a course. Bees may occasionally tear down worker-cells and build drone-cells in their place; but such action, I believe, is not sufficiently extensive to ever cause anxiety. I am also certain that bees that have to secrete wax to form comb, do much less gathering. Wax secretion seems voluntary, and when rapid seems to require quiet and great consumption of food. If we make two artificial colonies equally strong, supply the one with combs, and withhold them from the other,

we will find that this last sends much fewer bees to the fields, while all the bees are more or less engaged in wax secretion. Thus the other colony gains much more rapidly in honey, first, because more bees are storing; second, because less food is consumed. This is undoubtedly the reason why extracted-honey can be secured in far greater abundance than can comb-honey.

The foundation if used the full depth of the frame, stretches so that many cells are so enlarged as to be used for drone-brood. This demands, if we use the sheets unstrengthened, that they only be used as guides, not reaching more than one-third of the depth of the frame. Strips not less than four inches wide will not sag to do any harm. The foundation, too, should not quite reach the sides of the frame, as by expansion it is liable to warp and bend. Captain J. E. Hetherington has invented a cure for this stretching and warping, by strengthening the foundation. To do this, he runs several fine copper wires into the foundation as it passes through the machine.

I understand, too, that Mr. M. Metcalf, of this State, has a similar device now being patented.

This is a valuable suggestion, as it permits full-sized sheets of foundation to be inserted in the frames. I presume that very soon all worker-foundation will contain such wires.

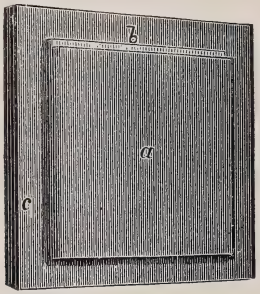
TO FASTEN THE FOUNDATION.

In the thin sections, the foundation can best be fastened by use of the melted wax. To accomplish this, I have used a block made thus: Saw a fifteen-sixteenths inch board so that it will just exactly fill a section. Screw this to a second board, which is one-half inch broader each way, so that the larger under board will project one-quarter of an inch each side the top board. Now set the section over the top board, place the foundation, cut a trifle shorter than the inside of the section, within, close to the top and one side of the section, and cause it to adhere by running on a little of the melted wax, which, by use of a kerosene lamp or stove, may be kept melted. If the basin is double-walled, with water in the outer chamber and wax in the inner, it is much safer, as then the wax will never burn.

If the tops of the sections are thick, they may be grooved, and by crowding the foundation into the groove, and, if necessary, pressing it with a thin wedge, it will be securely held.

This last method will work nicely in case of fastening into the brood-frames. But I have found that I could fasten them rapidly and very securely by simply pressing them against the rectangular projection from the top-bar already described (page 134). In this case a block (Fig. 68, *a*) should reach

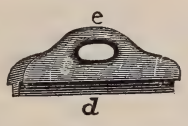
FIG. 68.



up into the frame from the side which is nearest to the rectangular projection—it will be remembered that the projection (Fig. 36) is a little to one side of the centre of the top-bar, so that the foundation shall hang exactly in the centre—so far that its upper surface would be exactly level with the upper surface of the rectangular projection. This block, like the one described above, has shoulders (Fig. 68, *c*), so that it will always reach just the proper distance into the frame. It is also rabbeted at the edge where the projection of the top-bar of the frame will rest, (Fig. 68, *b*), so that the projection has a solid support, and will not split off with pressure. We now set our frame on this block, lay on our foundation, cut the size we desire, which, unless strengthened, will be as long as the frame, and about four inches wide. The foundation will rest firmly on the projection and block, and touch the top-bar, at every point. We now take a board as thick as the projection is deep, and as wide (Fig. 69, *d*) as the frame is long, which may be trimmed off, so as to have a convenient handle (Fig. 69, *e*), and by wetting the edge of this (Fig.

69, *d*) either in water, or, better, starch-water, and pressing with it on the foundation above the projection, the foundation will be made to adhere firmly to the latter, when the frame may be raised *with the block*, taken off, and another fastened as before. I have practiced this plan for two years, and have had admirable success. I have very rarely known the founda-

FIG. 69.



tion to drop, though it must be remembered that our hives are shaded, and our frames small.

The above methods are successful, but probably will receive valuable modifications at the hands of the ingenius apiarists of our land. Study in this direction will unquestionably pay, as the use of this material is going to be very extensive, and any improvements will be hailed with joy by the bee-keeping fraternity.

SAVE THE WAX.

As foundation is becoming so popular, and is destined to come into general use, it behooves us all to be very careful that no old comb goes to waste. Soiled drone-comb, old, worthless worker-comb, and all fragments that cannot be used in the hives, together with cappings, after the honey is drained out through a coarse bag or colander—which process may be hastened by a moderate heat, not sufficient to melt the wax, and frequent stirring—should be melted, cleansed, and molded into cakes of wax, soon to be again stamped, not by the bees, but by wondrous art.

METHODS.

A slow and wasteful method is to melt in a vessel of heated water, and to purify by turning off the top, or allowing to cool, when the impurities at the bottom are scraped off, and the process repeated till all impurities are eliminated.

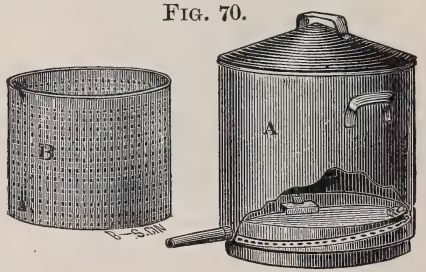
A better method to separate the wax is to put it into a strong, rather coarse bag, then sink this in water and boil.

At intervals the comb in the bag should be pressed and stirred. The wax will collect on top of the water.

To prevent the bag from burning, it should be kept from touching the bottom of the vessel by inverting a basin in the bottom of the latter, or else by using a double-walled vessel. The process should be repeated till the wax is perfectly cleansed.

But, as wax is to become so important, and as the above methods are slow, wasteful, and apt to give a poor quality of wax, specialists, and even amateurs who keep as many as ten or twenty colonies of bees, may well procure a wax extractor (Fig. 70). This is also a foreign invention, the

FIG. 70.



first being made by Prof. Gerster, of Berne, Switzerland. These cost from five to seven dollars, are made of tin, are very convenient and admirable, and can be procured of any dealer in apiarian supplies.

By this invention, all the wax, even of the oldest combs, can be secured, in beautiful condition, and as it is perfectly neat, there is no danger of provoking the "best woman in the world," as we are in danger of doing by use of either of the above methods—for what is more untidy and perplexing than to have wax boil over on the stove, and perhaps get on to the floor, and be generally scattered about.

All pieces of comb should be put into a close box, and if any larvæ are in it, the comb should be melted so frequently that it would not smell badly. By taking pains, both in collecting and melting, the apiarist will be surprised at the close of the season, as he views his numerous and beautiful cakes of comb, and rejoice as he thinks how little trouble it has all cost.

CHAPTER XV.

MARKETING HONEY.

No subject merits more attention by the apiarist than that of marketing honey. There is no question but that the supply is going to continually increase, hence, to sustain the price we must stimulate the demand, and by doing this we shall not only supply the people with a food element which is necessary to health, but we shall also supersede in part the commercial syrups, which are so adulterated as not only to be crowded with filth the most revolting, but are often even teeming with poison. (Report of Michigan Board of Health for 1874, pp. 75–79.) To bring, then, to our neighbor's table the pure, wholesome, delicious nectar, right from the hive, is philanthropy, whether he realizes it or not.

Nor is it difficult to stimulate the demand. I have given special attention to this topic for the last few years, and am free to say, that not a tithe of the honey is consumed in our country that might and should be.

HOW TO INVIGORATE THE MARKETS.

First. See that no honey goes to market from your apiary that is not in the most inviting form possible. Grade *all the honey thoroughly*, and expect prices to correspond with the grade. See that every package and vessel is not only attractive, but so arranged as not to make the dealer any trouble or cause him any vexation. One leaky can or crate may do great injury.

Second. See that every grocer in your vicinity has honey constantly on hand. Do all you can to build up a home market. The advice to sell to only one or two dealers is wrong and pernicious. Whether we are to buy or sell, we shall find almost always that it will be most satisfactory to deal with men whom we know, and who are close at hand. Only when

you outgrow your home market should you ship to distant places. This course will limit the supply in the large cities, and thus raise the prices in the great marts, whose prices fix those in the country. Be sure to keep honey constantly in the markets.

Third. Insist that each grocer makes the honey *very* conspicuous. If necessary, supply large, fine labels, with your own name almost as prominent as is that of the article.

Fourth. Deliver the honey in small lots, so that it will be sure to be kept in inviting form, and, if possible, attend to the delivery yourself, that you may know that all is done "decently and in order."

Fifth. Instruct your grocers that they may make the honey show to the best effect, and thus captivate the purchaser through the sight alone.

Sixth. *Call local conventions*, that all in the community may know and practice the best methods, so that the markets may not be demoralized by poor, unsalable honey.

Of course, the method of preparation will depend largely, and vary greatly, upon the style of honey to be sold, so we will consider these kinds separately.

EXTRACTED HONEY.

As before intimated, extracted honey has all the flavor, and is in every way equal, if not superior—comb itself is innutritious, and very indigestible—to comb-honey. When people once know its excellence—know that it is not "strained"—let us, as apiarists, strive in every way to kill that word—then the demand for this article will be vastly increased, to the advantage both of the consumer and the apiarist.

Explain to each grocer what we mean by the word extracted, and ask him to spread wide the name and character of the honey. Leave cups of the honey with the editors and men of influence, and get them to discuss its origin and merits. I speak from experience, when I say that in these ways the reputation and demand for extracted honey can be increased to a surprising degree, and with astonishing rapidity.

HOW TO TEMPT THE CONSUMER.

First. Have it chiefly in small cups—jelly cups are best.

Many persons will pay twenty-five cents for an article, when if it cost fifty cents they would not think of purchasing.

Second. Only put it in such vessels as jelly cups or glass fruit jars, etc., that will be useful in every household when the honey is gone, that the buyer may feel that the vessel is clear gain.

Third. Explain to the grocer that if kept above the temperature of 70° or 80° F., it will not granulate, that granulation is a pledge of purity and superiority, and show him how easy it is to reduce the crystals, and ask him to explain this to his customers. If necessary, liquify some of the granulated honey in his presence.

Lastly. If you do not deliver the honey yourself, be sure that the vessels will not leak in transit. It is best, in case jelly cups are used, that they be filled at the grocery. And don't forget the large label, which gives the kind of honey, grade, and producer's name.

COMB-HONEY.

This, from its wondrous beauty, especially when light-colored and immaculate, will always be a coveted article for the table, and will ever, with proper care, bring the highest price paid for honey. So it will always be best to work for this, even though we may not be able to procure it in such ample profusion as we may the extracted. He who has all kinds, will be able to satisfy every demand, and will most surely meet with success.

RULES TO BE OBSERVED.

This, too, should be chiefly in small sections (Fig. 50), for, as before stated, such are the packages that surely sell. Sections from four to six inches square will just fill a plate nicely, and look very tempting to the proud housewife, especially if some epicurean friends are to be entertained.

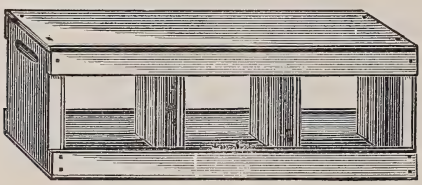
The sections should surely be in place at the dawn of the white clover season, so that the apiarist may secure the most of this irresistible nectar, chaste as if capped by the very snow itself. They should be taken away as soon as capped, as delay makes them highways of travel for the bees, which always mar their beauty.

When removed, if demanded, glass the sections, but before this, we should place in hives one upon another, or special boxes made tight, with a close cover, in which to store either brood-frames in winter or sections at any season, and sulphur them. This is quickly and easily done by use of the smoker. Get the fire in the smoker well to burning, add the sulphur, then place this in the top hive, or top of the special box. The sulphurous fumes will descend and deal out death to all moth larvæ. *This should always be done* before shipping the honey, if we regard our reputations as precious. It is well to do this immediately upon removal, and also two weeks after, so as to destroy the moth larvæ not hatched when the sections are removed.

If separators have been used, these sections are in good condition to be glassed, and are also in nice shape to ship even without glass, as they may stand side by side and not mar the comb.

The shipping-crate (Fig. 71) should be strong, neat and cheap, with handles as seen in Fig. 71—such handles are also

FIG. 71.



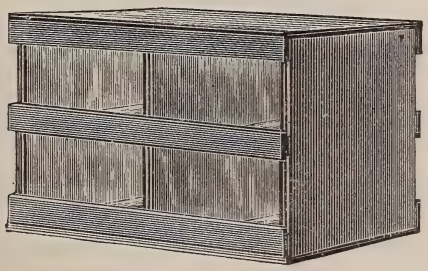
convenient in the ends of the hives, and can be cut in an instant by having the circular-saw set to wabble. With handles the crate is more convenient, and is more sure to be set on its bottom. The crate should also be glassed, as the sight of the comb will say: "Handle with care."

Mr. Heddon also makes a larger crate (Fig. 72), which is neat and cheap. Muth's crate is like Heddon's, only smaller.

It is well, too, to wrap the sections in paper, as thus breakage of one will not mean general ruin. However, this would be unnecessary in case the sections were of veneer and glassed, as before described.

In groceries, where the apiarist keeps honey for sale, it will pay him to furnish his own boxes. These should be made of white-wood, very neat, and glassed in front to show the honey, and the cover so fixed that unglassed sections—and these, probably, will soon become the most popular—cannot be punched or fingered. Be sure, too, that the label,

FIG. 72.



with kind of honey, grade, and name of apiarist, be so plain that "he who runs may read."

Comb-honey that is to be kept in the cool weather of autumn, or the cold of winter, must be kept in warm rooms, or the comb will break from the section when handled. By keeping it quite warm for some days previous to shipment, it may be sent to market even in winter, but must be handled very carefully, and must make a quick transit.

Above all, *let "taste and neatness" ever be your motto.*

CHAPTER XVI.

HONEY PLANTS.

As bees do not make honey, but only gather it, and as honey is mainly derived from certain flowers, it of course follows that the apiarist's success will depend largely upon the abundance of honey-secreting plants in the vicinity of his apiary. True it is that certain bark and plant lice secrete a kind of liquid sweet—honey of doubtful reputation—which, in the dearth of anything better, the bees seem glad to appropriate. I have thus seen the bees thick about a large bark-louse which attacks the tulip tree, and thus often destroys one of our best honey trees. This is an undescribed species of the genus *Lecanium*. I have also seen them thick about three species of plant lice. One, the *Pemphigus imbricator*, Fitch, works on the beech tree. Its abdomen is thickly covered with long wool, and it makes a comical show as it wags this up and down upon the least disturbance. The leaves of trees attacked by this louse, as also those beneath the trees, are fairly gummed with a sweetish substance. I have found that the bees avoid this substance, except at times of extreme drouth and long protracted absence of honeyed bloom. It was the source of no inconsiderable stores during the terribly parched autumn of Chicago's great disaster.

Another species of *Pemphigus* gives rise to certain solitary plum-like galls, which appear on the upper surface of the red elm. These galls are hollow, with a thin skin, and within the hollows are the lice, which secrete an abundant sweet that often attracts the bees to a feast of fat things, as the gall is torn apart, or cracks open, so that the sweet exudes. This sweet is anything but disagreeable, and may not be unwholesome to the bees.

Another aphis, of a black hue, works on the branches of our

willows, which they often entirely cover, and thus greatly damage another tree valuable for both honey and pollen. Were it not that they seldom are so numerous two years in succession, they would certainly banish from among us one of our most ornamental and valuable honey-producing trees. These are fairly thronged in September and October, and not unfrequently in spring and summer if the lice are abundant, by bees, wasps, ants, and various two-winged flies, all eager to lap up the oozing sweets. This louse is doubtless the *Lachnus dentatus*, of Le Baron, and the *Aphis salicti*, of Harris.

Bees also get, in some regions, a sort of honey-dew, which enables them to add to their stores with surprising rapidity. I remember one morning while riding on horseback along the Sacramento river, in California, I broke off a willow twig beside the road when, to my surprise, I found it was fairly decked with drops of honey. Upon further examination I found the willow foliage was abundantly sprinkled by these delicious drops. These shrubs were undisturbed by insects, nor were they under trees. Here then was a real case of honey-dew, which must have been distilled through the night by the leaves. I never saw any such phenomenon in Michigan, yet others have. Dr. A. H. Atkins, an accurate and conscientious observer, has noted this honey-dew more than once here in Central Michigan.

Bees also get some honey from oozing sap, some of questionable repute from about cider mills, some from grapes and other fruit which have been crushed, or eaten and torn by wasps and other insects. That bees ever tear the grapes is a question of which I have failed to receive any personal proof, though for years I have been carefully seeking it. I have lived among the vineyards of California, and have often watched bees about vines in Michigan, but never saw bees tear open the grapes. I have laid crushed grapes in the apiary, when the bees were not gathering, and were ravenous for stores, which, when covered with sipping bees, were replaced with sound grape-clusters, which in no instance were mutilated. I have thus been led to doubt if bees ever attack sound grapes, though quick to improve the opportunities which the oriole's beak and the stronger jaws of wasps offer them. Still, Prof. Riley feels sure that bees are sometimes

thus guilty, and Mr. Bidwell tells me he has frequently seen bees rend sound grapes, which they did with their feet. Yet, if this is the case, it is certainly of rare occurrence, and is more than compensated by the great aid which the bees afford the fruit-grower in the great work of cross-fertilization, which is imperatively necessary to his success, as has been so well shown by Dr. Asa Gray and Mr. Chas. Darwin. It is true that cross-fertilization of the flowers, which can only be accomplished by insects, and early in the season by the honey-bee, is often, if not always necessary to a full yield of fruit and vegetables. I am informed by Prof. W. W. Tracy, that the gardeners in the vicinity of Boston keep bees that they may perform this duty. Even then, if Mr. Bidwell and Prof. Riley are right, and the bee does, rarely—for surely this is very rare, if ever—destroy grapes, still they are, beyond any possible question, invaluable aids to the pomologist.

But the principal source of honey is still from the flowers.

WHAT ARE THE VALUABLE HONEY PLANTS?

In the northeastern part of our country the chief reliance for May is the fruit-blossoms, willows, and sugar maples. In June white clover yields largely of the most attractive honey, both as to appearance and flavor. In July the incomparable basswood makes both bees and apiarist jubilant. In August buckwheat offers a tribute, which we welcome, though it be dark and pungent in flavor, while with us in Michigan, August and September give us a profusion of bloom which yields to no other in the richness of its capacity to secrete honey, and is not cut off till the autumn frosts—usually about September 15.

Thousands of acres of golden rod, boneset, asters, and other autumn flowers of our new northern counties, as yet have blushed unseen, with fragrance wasted. This unoccupied territory, unsurpassed in its capability for fruit production, covered with grand forests of maple and basswood, and spread with the richest of autumn bloom, offers opportunities to the practical apiarist rarely equaled except in the Pacific States, and not even there, when other privileges are considered. In these localities, two or three hundred pounds to the colony is no surprise to the apiarist, while even four or five hundred are not isolated cases.

In the following table will be found a list of valuable honey plants. Those in the first column are annual, biennial or perennial; the annual being enclosed in a parenthesis thus: (); the biennial enclosed in brackets thus: []; while those in the second column are shrubs or trees; the names of shrubs being enclosed in a parenthesis. The date of commencement of bloom is, of course, not invariable. The one appended, in case of plants which grow in our State, is about average for Central Michigan. Those plants whose names appear in small capitals yield very superior honey. Those with (*a*) are useful for other purposes than honey secretion. All but those with a * are native or very common in Michigan. Those written in the plural refer to more than one species. Those followed by a † are very numerous in species. Of course I have not named all, as that would include some hundreds which have been observed at the college, taking nearly all of the two great orders Compositæ and Rosaceæ. I have only aimed to give the most important, omitting many foreign plants of notoriety, as I have had no personal knowledge of them:

DATE.	Annuals or Perennials.	DATE.	Shrubs or Trees.
April.....	Dandelion.	March and Ap'l	Red or Soft Maple.(*a*)
April and May.	Strawberry.(*a*)	March and Ap'l	Poplar or Aspen.
May and June .	*White Sage, California	March and Ap'l	Silver Maple.
May and June .	*Sumac, California.	March and Ap'l	*Judas Tree.
May and June .	*CoffeeBerry,California	April and May.	(Willows)† also Trees.
June to July ...	WHITE CLOVER.(*a*)	April and May.	*Judas Tree—South.
June to July ...	ALSIKE CLOVER.(*a*)	May.....	(Shad-bush.)
June to July ...	*[SWEET CLOVER.]	May.....	(Alder.)
June to July ...	*Horehound. [Weed.	May.....	Maples-Sugar Maple(*a*)
June to July ...	Ox-eyed Daisy—Bad	May.....	Crab Apple.
June to July ...	Bush Honeysuckle.	May.....	(Hawthorns.)
June to August	*Sage,	May.....	(Fruit Trees—Apple, Plum, Cherry, Pear, etc.(*a*)
June to August	Mother-wort.		
June to frost...	*(Borage.)		
June to frost...	*(Cotton.)(*a*)	May.....	(Currant and Gooseberry.)(*a*)
June to frost...	Silk or Milk Weeds.		
June to frost...	(Mustard)†	May.....	*(Wistaria Vine- South)
June to frost...	*(Rape.)(*a*)	May.....	(Chinese Wistaria Vine—South.)
June to frost...	St. John's Wort.		
June to frost...	(MIGNONETTE.)(*a*)	May and June..	(Barberry.)
July.....	(Corn.)(*a*)	May and June..	(Grape-vine.)(*a*)
July.....	*(Teasel.)(*a*)	May and June..	Tulip-tree.
July to August.	*Catnip.(*a*)	May and June..	(Sumac.)
July to August.	Asparagus.(*a*)	June	Wild-Plum.
July to August.	*(Rocky M't.Bee Plant)	June	(Black Raspberry.)(*a*)
July to frost....	Boneset.	June	Locusts.
July to frost....	Bergamot.	June	(RED RASPBERRY.)(*a*)
July to frost....	Figwort.	June	(Blackberry.)
August.....	(Buckwheat.)(*a*)	June to July ...	*Sourwood—South.
August.....	(Snap-dragon.)	July.....	(Button Bush.)
August to frost	(GOLDEN ROD.)†	July.....	BASSWOOD.(*a*)
August to frost	Asters.†	July.....	(Virginia Creeper.)(*a*)
August to frost	Marsh Sun-Flowers.	July to August.	*Pepper-tree, Cal'a.
August to frost	Tick-Seed.	July to Sept....	*(St. John's Worts.)
August to frost	Beggar-Ticks.	August.....	(Late Sumac.)
August to frost	Spanish Needles.	August to Sept.	*Red Gum, California.

DESCRIPTION WITH PRACTICAL REMARKS.

As this subject of bee pasturage is of such prime importance, and as the interest in the subject is so great and widespread, I feel that details with illustrations will be more than warranted.

We have abundant experience to show that forty or fifty

FIG. 73.—*Maple.*



colonies of bees, take the seasons as they average, are all that a single place will sustain to the greatest advantage. Then, how significant the fact, that when the season is the best, full

three times that number of colonies will find ample resources to keep all employed. So this subject of artificial pasturage becomes one well worthy close study and observation. The subject, too, is a very important one in reference to the location of the apiary.

It is well to remember in this connection, that two or three miles should be regarded as the limit of profitable gathering. That is, apiaries of from fifty to one hundred or more colonies, should not be nearer than four or five miles of each other.

APRIL PLANTS.

As we have already seen, the apiarist does not secure the best results, even in the early spring, except the bees are encouraged by the increase of their stores of pollen and honey; hence, in case we do not practice stimulative feeding —and many will not—it becomes very desirable to have some

FIG. 74—*Willow.*



early bloom. Happily, in all sections of the United States our desires are not in vain.

Early in spring there are many scattering wild flowers, as the blood-root (*Sanguinaria canadensis*), liver-leaf (*Hepa-*

tica acutiloba), and various others of the crofoot family, as also many species of cress, which belong to the mustard family, etc., all of which are valuable and important.

The maples (Fig. 73), which are all valuable honey plants, also contribute to the early stores. Especially valuable are the silver maples (*Acer dasycarpum*), and the red or soft maples (*Acer rubrum*), as they bloom so very early, long before the leaves appear. The bees work on these, here in Michigan, the first week of April, and often in March. They are also magnificent shade trees, especially those that have the weeping habit. Their early bloom is very pleasing, their summer form and foliage beautiful, while their flaming tints in autumn are indescribable. The foreign maples, sycamore, *Acer pseudo-platanus*, and Norway, *Acer platanoides*, are also very beautiful. Whether superior to ours as honey plants, I am unable to say.

The willows, too (Fig. 74), rival the maples in the early period of bloom. Some are very early, blossoming in March, while others, like the white willow (*Salix alba*) (Fig. 74), bloom in May. The flowers on one tree or bush of the willow are all pistillate, that is, have pistils, but no stamens, while

FIG. 75.—*Judas Tree*



on others they are all staminate, having no pistils. On the former, they can gather only honey, on the latter only pollen. That the willow furnishes both honey and pollen is attested by the fact that I saw both kinds of trees, the pistillate and the staminate, thronged with bees the past season. The willow, too, from its elegant form and silvery foliage, is one of our finest shade trees.

In the south of Michigan, and thence southward to Kentucky, and even beyond, the Judas tree, or red-bud, *Cercis canadensis* (Fig. 75), is not only worthy of cultivation as a honey plant, but is also very attractive, and well deserving of attention for its ornamental qualities alone. This blooms from March to May, according to the latitude.

The poplars—not the tulip—also bloom in April, and are freely visited by the bees. The wood is immaculate, and is used for toothpicks. Why not use it for honey-boxes?

MAY PLANTS.

In May we have the grand sugar maple, *Acer saccharinum* (Fig. 73), incomparable for beauty, also all our various fruit trees, peach, cherry, plum, apple, etc., in fact all the Rosaceæ

FIG. 76.—*American Wistaria.*



family. Our beautiful American Wistaria, *Wistaria frutescens* (Fig. 76), the very ornamental climber, or the still more lovely Chinese Wistaria, *Wistaria sinensis* (Fig. 77), which has longer racemes than the native, and often blossoms twice in the season. These are the woody twiners for the apiarist.

The barberry, too, *Berberis vulgaris* (Fig. 78), comes after fruit blossoms, and is thronged with bees in search of nectar

FIG. 77.—*Chinese Wistaria.*



in spring, as with children in winter, in quest of the beautiful scarlet berries, so pleasingly tart.

FIG. 78 —*Barberry.*



In California, the sumac, the coffee berry, and the famous white sage (Fig. 79), keep the bees full of activity.



FIG. 79.—*White Sage.*

JUNE PLANTS.

With June comes the incomparable white or Dutch clover, *Trifolium repens* (Fig. 80), whose chaste and modest bloom

FIG. 80.—*White or Dutch Clover.*



betokens the beautiful, luscious, and unrivalled sweets which are hidden in its corolla tube. Also its sister, Alsike or Swedish, *Trifolium hybrida* (Fig. 81), which seems to resemble both the white and red clover. It is a stronger grower than the white, and has a whitish blossom tinged with pink. This forms excellent pasture and hay for cattle, sheep, etc., and may well be sown by the apiarist. It will often pay apiarists to furnish neighbor farmers with seed as an inducement to grow this *par excellent* honey plant. Like white clover, it blooms all through June into July. Both of these should be sown early in spring with timothy, five or six pounds of seed to the acre, in the same manner that red clover seed is sown.

Sweet clover, yellow and white, *Melilotus officinalis* (Fig. 82), and *Melilotus alba* , are well named. They bloom from the middle of June to the middle of July. Their perfume scents the air for long distances, and the hum of bees that throng their flowers is like music to the apiarist's ear. The honey, too, is just exquisite. These clovers are biennial, not



FIG. 81.—*Alsike Clover.*

FIG. 82.—*Melilot Clover*



blooming the first season, and dying after they bloom the second season. Another disagreeable fact, they have no value

FIG. 83.—*Borage.*



except for honey. They are said to become pernicious weeds if allowed to spread.

The other clovers—lucerne, yellow trefoil, scarlet trefoil, and alfalfa—have not proved of any value with us, perhaps owing to locality.

Borage, *Borago officinalis* (Fig. 83), an excellent bee plant, blooms from June till frost, and is visited by bees even

FIG. 84.—*Mignonette.*



in very rainy weather. It seems not to be a favorite, but is eagerly visited when all others fail to yield nectar.

FIG. 85.—*Okra.*



Mignonette, *Reseda odorata* (Fig. 84), blooms from the middle of June till frost, is unparalleled for its sweet odor, furnishes nectar in profusion, and is well worthy cultivation.

It does not secrete well in wet weather, but in favorable weather it is hardly equalled.

Okra or gumbo, *Hibiscus esculentus*, (Fig. 85), also blooms in June. It is as much sought after by the bees in quest of honey, as by the cook in search of a savory vegetable, or one to give tone to soup.

Sage, *Salvia officinalis*, horehound, *Marrubium vulgare*, motherwort, *Leonurus cardiaca*, and catnip, *Nepeta cataria*, which latter does not commence to bloom till July, all furnish nice white honey, remain in bloom a long time, and are very desirable, as they are in bloom in the honey dearth of July and August. They, like many others of the mint family (Fig. 86), are thronged with bees during the season of bloom.

FIG. 86.—*Mint.*

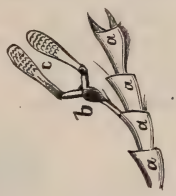


The first and last are of commercial importance, and all may well be introduced by apiarists, wherever there is any space or waste ground.

The silk or milk-weed furnishes abundant nectar from June to frost, as there are several species of the genus Asclepias, which is wide-spread in our country. This is the plant which has large pollen masses which often adhere to the legs of bees (Fig. 87), and sometimes so entrap them as to cause their death. Prof. Riley once very graciously advised

planting them to kill bees. I say graciously, as I have watched these very closely, and am sure they do little harm, and are rich in nectar. Seldom a bee gets caught so as to hold it long, and when these awkward masses are carried

FIG. 87.—*Pollen of Milk-weed.*



away with the bee, they are usually left at the door of the hive, where I have often seen them in considerable numbers. The river bank hard by our apiary is lined with these sweet-smelling herbs, and we would like even more.

FIG. 88.—*Black Mustard.*



Black mustard, *Sinapis nigra* (Fig. 88) white mustard, *Sinapis alba*, and rape, *Brassica campestris* (Fig. 89), all look much alike, and are all admirable bee plants, as they furnish much and beautiful honey. The first, if self-

sown, blooms July 1st, the others June 1st; the first about eight weeks after sowing, the others about four. The mustards bloom for four weeks, rape for three. These are all specially commendable, as they may be made to bloom during the honey dearth of July and August, and are valuable plants to raise for the seed. Rape seems to be very attractive to insects, as the flea beetles and the blister beetles are often quite too much for it, though they do not usually destroy the plants till after they have blossomed. I have several times

FIG. 89.—*Rape.*



purchased what purported to be Chinese mustard, dwarf and tall, but Prof. Beal, than whom there is no better authority, tells me they are only the white and black, and certainly, they are no whit better as bee plants. These plants, with buckwheat, the mints, borage and mignonette, are specially interesting, as they cover, or may be made to cover, the honey dearth from about July 20th to August 20th.

The mustards and rape may be planted in drills about eight inches apart, any time from May 1st to July 15th. Four quarts will sow an acre.

In this month blooms the tulip tree, *Liriodendron tulipifera* (Fig. 90)—often called poplar in the South—which is not only an excellent honey producer, but is one of our most

stately and admirable shade-trees. Now, too, bloom the sumacs, though one species blooms in May, the wild plum, the raspberries, whose nectar is unsurpassed in color and flavor, and the blackberry. Corn, too, is said by many to yield largely of honey as well as pollen, and the teasel, *Dipsacus*

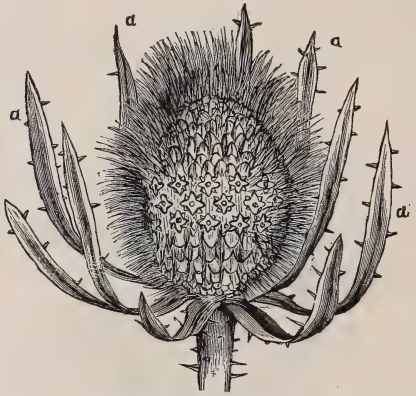
FIG. 90.—*Tulip*



fullonum (Fig. 91), is said, not only by Mr. Doolittle, but by English and German apiarists, to yield richly of beautiful honey. This last, too, has commercial importance. The

blackberry opens its petals in June, and also the fragrant locust, which, from its rapid growth, beautiful form and handsome foliage, would rank among our first shade trees, except that it is so tardy in spreading its canopy of green, and so liable to ruinous attack by the borers, which last peculiarity it

FIG. 91.—*Teasel.*



shares with the incomparable maples. Washing the trunks of the trees in June and July with soft soap, will in great part remove this trouble.

FIG. 92.—*Cotton.*



Now, too, our brothers of the South reap a rich harvest from the great staple, cotton (Fig. 92), which commences to

bloom early in June, and remains in blossom even to October. This belongs to the same family—Mallow—as the hollyhock, and like it, blooms and fruits through the season.

JULY PLANTS.

Early in this month opens the far-famed basswood or linden, *Tilia Americana* (Fig. 93), which, for the profusion

FIG. 93.—*Basswood.*



and quality of its honey has no superior. The tree, too, from its great spreading top and fine foliage, is magnificent for shade. Five of these trees are within two rods of my study window, and their grateful fragrance, and beautiful form and shade, have often been the subject of remark by visitors.

Figwort, *Scrophularia nodosa* (Fig. 94), often called rattle-weed, as the seeds will rattle in the pod, and carpenter's square, as it has a square stalk, is an insignificant looking weed, with inconspicuous flowers, that afford abundant nectar from the middle of July till frost. I have received almost as many for identification as I have of the asters and golden-rods. Prof. Beal remarked to me a year or two since, that it hardly seemed possible, that it could be so valuable. We

cannot always rightly estimate by appearances alone. It is a very valuable plant to be scattered in waste places.

That beautiful and valuable honey plant, from Minnesota, Colorado, and the Rocky Mountains, cleome, or the Rocky Mountain bee-plant, *Cleome integrifolia* (Fig. 96), if self-sown, or sown early in spring, blooms by the middle of July, and lasts for long weeks. Nor can anything be more gay than these brilliant flowers, alive with bees all through the long fall. This should be planted in fall or spring, in drills two feet apart, the plants six inches apart in the drills. The seeds, which grow in pods, are very numerous, and are said to be valuable for chickens. Now, too, commences to bloom the numerous eupatoriums, or bonesets, or thoroughworts

FIG. 94.—*Figwort.*



(Fig. 97), which fill the marshes of our country, and the hives as well, with their rich golden nectar—precursors of that profusion of bloom of this composite order, whose many species are even now budding in preparation for the sea of flowers which will deck the marsh-lands of August and September. Wild bergamot, too, *Monarda fistulosa*, which, like the thistles, is of importance to the apiarist, blooms in July.

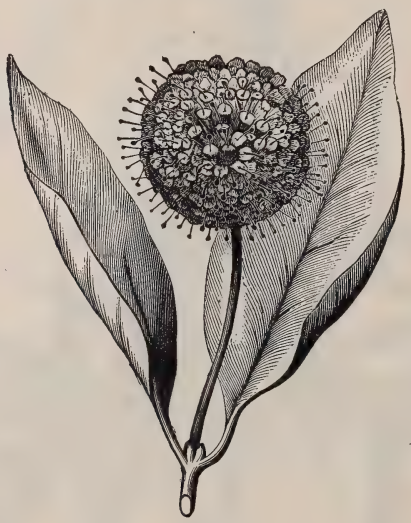
The little shrub of our marshes, appropriately named button-bush, *Cephalanthus occidentalis*, (Fig. 95), also shares the attention of the bees with the linden. While our brothers



FIG. 96.—*Rocky Mountain Bee-Plant.*

of the South find the sour-wood, or sorrel tree, *Oxydendrum arboreum*, a valuable honey tree. This belongs to the Heath family, which includes the far-famed heather bloom of England. It also includes our whortleberry, cranberry, blueberry, and one plant which has no enviable reputation, as furnishing honey, which is very poisonous, even fatal to those who eat, the mountain laurel, *Kalmia latifolia*. Yet, a near relative of the South *Andromeda nitida*, is said to furnish beautiful and wholesome honey in great quantities. The Virginia creeper also blooms in July. I wish I could say that this beautiful vine, transplendent in autumn, is a favorite with the honey-bee. Though it often, nay always, swarms with wild

FIG. 95.—*Button Bush.*



bees when in blossom, yet I never saw a honey-bee visit the ample bloom amidst its rich, green, vigorous foliage. Now, too, the St. John's wort, *Hypericum*, with its many species, both shrubby and herbaceous, offers bountiful contributions to the delicious stores of the honey-bee. The catnip, too, *Nepeta cataria*, and our cultivated asparagus—which if



FIG. 97.—*Boneset.*

uncut in spring will bloom in June—so delectable for the table, and so elegant for trimming table meats and for banquets in autumn, come now to offer their nectarian gifts.

AUGUST AND SEPTEMBER PLANTS.

The cultivated buckwheat, *Fagopyrum esculentum*, (Fig. 98), usually blooms in August, as it is sown the first of July —three pecks per acre is the amount to sow—but by sowing the first of June, it may be made to bloom the middle of

FIG. 98.—*Buckwheat.*



July, when there is generally, in most localities, an absence of nectar-secreting flowers. The honey is inferior in color and flavor, though some people prefer this to all other honey. The silver-leaf buckwheat blooms longer, has more numerous flowers, and thus yields more grain than the common variety.

Now, too, come the numerous golden-rods. The species of this genus, *Solidago* (Fig. 99), in the Eastern United States, number nearly two-score, and occupy all kinds of soils, and are at home on upland, prairie and morass. They yield abundantly of rich, golden honey, with flavor that is unsurpassed by any other. Fortunate the apiarist who can boast of a thicket of *Solidagoes* in his locality.

The many plants usually styled sun-flowers, because of their resemblance to our cultivated plants of that name, which deck the hill-side, meadow and marsh-land, now unfurl

FIG. 99.—*Golden-Rod.*



their showy involucres, and open their modest corollas, to invite the myriad insects to sip the precious nectar which each of the clustered flowers secretes. Our cultivated sun-flowers, I think, are indifferent honey plants, though some

FIG. 100.—*Sun Flower.*



think them big with beauty, and their seeds are relished by poultry. But the asters (Fig. 100), so wide-spread, the

beggar-ticks, *Bidens*, and Spanish-needles of our marshes, the tick-seed, *Coreopsis*, also, of the low, marshy places, with hundreds more of the great family Compositæ, are replete with precious nectar, and with favorable seasons make the apiarist who dwells in their midst jubilant, as he watches the bees, which fairly flood the hives with their rich and delicious honey. In all of this great family, the flowers are small and inconspicuous, clustered in compact heads, and when the plants are showy with bloom, like the sun-flowers, the brilliancy is due to the involucre, or bracts which serve as a frill to decorate the more modest flowers.

I have thus mentioned the most valuable honey plants of our country. Of course there are many omissions. Let all apiarists, by constant observation, help to fill up the list.

BOOK ON BOTANY.

I am often asked what books are best to make apiarists botanists. I am glad to answer this question, as the study of botany will not only be valuable discipline, but will also furnish abundant pleasure, and more, give important practical information. Gray's Lessons, and Manual of Botany, in one volume, published by Ivison, Phinney, Blakeman & Co., New York, is the most desirable treatise on this subject.

PRACTICAL CONCLUSIONS.

It will pay well for the apiarist to decorate his grounds with soft and silver maples, for their beauty and early bloom. If his soil is rich, sugar maples and lindens may well serve a similar purpose. The Judas tree, too, and tulip trees, both North and South, may well be made to ornament the apiarist's home. For vines, obtain the wistarias.

Sow and encourage the sowing of Alsike clover and silver-leaf buckwheat in your neighborhood. Be sure that your wife, children and bees, can often repair to a large bed of the new giant or grandiflora mignonette, and remember that it, with cleome and borage, blooms till frost. Study the bee plants of your region, and then study the above table, and provide for a succession, remembering that the mustards, rape and buckwheat may be made to bloom almost at pleasure, by sow-

ing at the proper time. Don't forget that borage and the mustards seem comparatively indifferent to wet weather. Be sure that all waste places are stocked with motherwort, catnip, asters, etc.

The above dates are only true for the most part in Michigan and Northern Ohio, and for more Southern latitudes must be varied, which by comparison of a few, as the fruit trees, becomes no difficult matter.

CHAPTER XVII.

WINTERING BEES.

This is a subject, of course, of paramount importance to the apiarist, as this is the rock on which some of even the most successful have recently split. Yet I come fearlessly to consider this question, as from all the multitude of disasters I see no occasion for discouragement. If the problem of successful wintering has not been solved already, it surely will be, and that speedily. So important an interest was never yet vanquished by misfortune, and there is no reason to think that history is now going to be reversed. Even the worst aspect of the case—in favor of which I think, though in opposition to such excellent apiarists as Marvin, Heddon, etc., that there is no proof, and but few suggestions even—that these calamities are the effects of an epidemic, would be all powerless to dishearten men trained to reason from effect to cause. Even an epidemic—which would by no means skip by the largest, finest apiaries, owned and controlled by the wisest, most careful, and most thoughtful, as has been the case in the "winters of our late discontent"—nor only choose winters of excessive cold, or following great drouth and absence of honey secretion in which to work its havoc—would surely yield to man's invention.

THE CAUSE OF DISASTROUS WINTERING.

Epidemic, then, being set aside as no factor in the solution, to what shall we ascribe such wide-spread reverses. I fully believe, and to no branch of this subject have I given more thought, study, and observation, that all the losses may be traced either to unwholesome food, failure in late breeding of the previous year, extremes of temperature, or to protracted cold with excessive dampness. I know from actual and wide-spread observation, that the severe loss of 1870 and

1871 was attended in this part of Michigan with unsuitable honey in the hive. The previous autumn was unprecedentedly dry. Flowers were rare, and storing was largely from insect secretion, and consequently the stores were unwholesome. I tasted of honey from many hives only to find it most nauseating. I fully believe that had the honey been thoroughly extracted the previous autumn, and the bees fed good honey or sugar, no loss would have been experienced. At least it is significant that all who did so, escaped, even where their neighbors all failed. Nor less so the fact that when I discovered eight of my twelve colonies dead, and four more just alive, I cleaned the remaining ones all out, and to one no worse nor better than the others I gave good capped honey stored early the previous summer, while the others were left with their old stores, that one lived and gave the best record I have ever known, the succeeding season, while all the others died.

Again, suppose that after the basswood season in July, there is no storing of honey, either from want of space, or from lack of bloom. In this case brood-rearing ceases. Yet if the weather is dry and warm, as of course it will be in August and September, the bees continue to wander about, death comes apace, and by autumn the bees are reduced in numbers, old in days, and illy prepared to brave the winter and perform the duties of spring. I fully believe that if all the colonies of our State and country had been kept breeding by proper use of the extractor, and feeding, even till into October, we should have had a different record, especially as to spring dwindling, and consequent death. In the autumn of 1872 I kept my bees breeding till the first of October. The following winter I had no loss, while my neighbors lost all of their bees.

Extremes of heat and cold are also detrimental to the bees. If the temperature of the hive becomes too high the bees become restless, eat more than they ought, and if confined to their hives are distended with their fœces, become diseased, besmear their comb and hives, and die. If when they become thus disturbed, they could have a purifying flight, all would be well.

Again, if the temperature becomes extremely low, the bees to keep up the animal heat must take more food; they are uneasy,

exhale much moisture, which may settle and freeze on the outer combs about the cluster, preventing the bees from getting the needed food, and thus in this case both dysentery and starvation confront the bees. That able and far-seeing apiarist the lamented M. Quinby, was one of the first to discover this fact; and here as elsewhere gave advice that if heeded, would have saved great loss and sore disappointment.

I have little doubt, in fact I know from actual investigation, that in the past severe winters, those bees which under confinement have been subject to severe extremes, are the ones that have invariably perished. Had the bees been kept in a uniform temperature ranging from 35° to 45° F., the record would have been materially changed.

Excessive moisture, too, especially in cases of protracted cold, is always to be avoided. Bees, like all other animals, are constantly giving off moisture, which of course will be accelerated if the bees become disturbed, and are thus led to consume more food. This moisture not only acts as explained above, but also induces fungus growths. The mouldy comb is not wholesome, though it may never cause death. Hence another necessity of sufficient warmth to drive this moisture from the hive and some means to absorb it without opening the hive above and permitting a current, which will disturb the bees, and cause the greater consumption of honey.

THE REQUISITE TO SAFE WINTERING—GOOD FOOD.

To winter safely, then, demands that the bees have thirty pounds by weight not guess—I have known three cases when *guessing* meant *starvation*—of good capped honey (coffee A sugar is just as good). If desired this may be fed as previously explained, which should be done so early that all will be capped during the warm days of October. Let us be wary how we trust even crystallized glucose. It might be safe during a warm winter, when the bees would have frequent flights, yet prove disastrous in a cold winter. Let us use it cautiously till its merits are assured. I prefer, too, that some of the comb in the centre of the hive has empty cells, to give a better chance to cluster, and that all the combs have a small hole through the centre, that the bees may pass freely through. This hole may simply be cut with a knife, or a tin

tube the size of one's finger may be driven through the comb, and left in if desired, in which case the comb should be pushed out of the tube, and the tube be no longer than the comb is thick. This perforatory work I always do early in October, when I extract all uncapped honey, take out all frames after I have given them the 30 lbs., *by weight*, of honey, confine the space with a division-board, cover with the quilt and chaff, and then leave undisturbed till the cold of November calls for further care.

SECURE LATE BREEDING.

Keep the bees breeding till the first of October. Except in years of excessive drouth, this will occur in many parts of Michigan without extra care. Failure may result from the presence of worthless queens. Any queens which seem not to be prolific should be superseded whenever the fact becomes evident. *I regard this as most important.* Few know how much is lost by tolerating feeble, impotent queens in the apiary, whose ability can only keep the colonies alive. Never keep such queens about. Here, then, is another reason for always keeping extra queens on hand. Even with excellent queens, a failure in the honey yield may cause breeding to cease. In such cases, we have only to feed as directed under the head of feeding.

TO SECURE AND MAINTAIN THE PROPER TEMPERATURE.

We ought also to provide against extremes of temperature. It is desirable to keep the temperature between 35° and 50° F. through the entire winter, from November to April. If no cellar or house is at hand, this may be accomplished as follows: Some pleasant dry day in late October or early November, raise the stand and place straw beneath; then surround the hive with a box a foot outside the hive, with movable top and open on the east; or else have a long wooden tube, opposite the entrance, to permit flight. This tube should be six or eight inches square, to permit easy examination in winter. The same end may be gained by driving stakes and putting boards around. When we crowd between the box and the hive either straw, chaff, or shavings. After placing a good thickness of straw above the

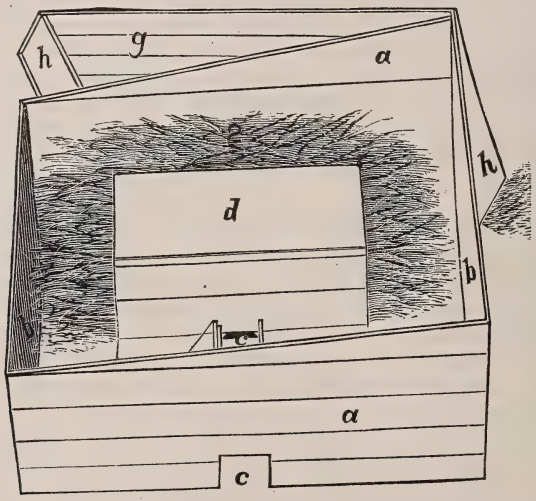
hive, lay on the cover of the box, or cover with boards. This preserves against changes of temperature during the winter, and also permits the bees to fly if it becomes necessary from a protracted period of warm winter weather. I have thus kept all my bees safely during two of the disastrous winters.

As there is at present no plan of wintering, which promises to serve so well for all our apiarists, in view of its cheapness, ease, convenience, and universal efficiency, I will describe in detail the box now in use at the College, which costs only one dollar per hive, and which is convenient to store away in summer.

BOX FOR PACKING.

The sides of this (Fig. 101, *a*, *a*), facing east and west are three and a half feet long, and two feet high on the south end,

FIG. 101.



and two and a half feet on the north. They are in one piece, which is secured by nailing the boards which form them to cleats, which are one inch from the ends. The north end

(Fig. 101, *b*) is three feet by two and a half feet, the south (Fig. 101, *b*), three feet by two, and made the same as are the sides. The slanting top of the sides (Fig. 101, *a*, *a*) is made by using for the upper board, the strip formed by sawing diagonally from corner to corner a board six inches wide and three feet long. The cover (Fig. 101, *g*), which is removed in the figure, is large enough to cover the top and project one inch at both ends. It should be battened, and held in one piece by cleats (Fig. 101, *h*) four inches wide, nailed on to the ends. These will drop over the ends of the box, and thus hold the cover in place, and prevent rain and snow from driving in. When in place this slanting cover permits the rain to run off easily, and will dry quickly after a storm. By a single nail at each corner the four sides may be tacked together about the hives, when they can be packed in with straw (Fig 101), which should be carefully done if the day is cold, so as not to disquiet the bees. At the centre and bottom of the east side (Fig. 101, *c*), cut out a square eight inches each way, and between this and the hive place a bottomless tube (the top of this tube is represented as removed in figure to show entrance to hive), before putting around the straw and adding the cover. This box should be put in place before the bleak cold days of November, and retained in position till the stormy winds of April are passed by. This permits the bees to fly when very warm weather comes in winter or spring, and requires no attention from the apiarist. By placing two or three hives close together in autumn—*yet never move the colonies more than three or four feet* at any one time, as such removals involve the loss of many bees—one box may be made to cover all, and at less expense. Late in April these may be removed and packed away, and the straw carried away, or removed a short distance and burned.

CHAFF HIVES.

Messrs. Townley, Butler, Root, and others, prefer chaff hives, which are simply double-walled hives, with the four or five inch chambers filled with chaff. The objection to these I take to be: First, Danger that so limited a space would not answer in severe seasons; Second, That such cumbrous

hives would be inconvenient to handle in summer; and, Third, A matter of expense. That they would in part supply the place of shade, is, perhaps, in their favor, while Mr. A. I. Root thinks they are not expensive.

WINTERING IN CELLAR OR HOUSE.

With large apiaries the above method is expensive, and specialists may prefer a cellar or special depository, which I think are quite as safe, though they demand attention and perhaps labor in winter. After my experience in the winter of 1874 and 1875, losing all my bees by keeping them in a house with double walls filled in with saw-dust, in which the thermometer indicated a temperature below zero for several weeks, in which time my strongest colonies literally starved to death in the manner already described, I hesitate to recommend a house above ground for Michigan, though with very numerous colonies it might do. Such a house must, if it answer the purpose, keep an equable temperature, at least 3° and not more than 10° above freezing, be perfectly dark, and ventilated with tubes above and below, so arranged as to be closed or opened at pleasure, and not admit a ray of light.

A cellar in which we are sure of our ability to control the temperature, needs to be also dry, dark, and quiet, and ventilated as described above. As already stated, the ventilator to bring air may well be made of tile, and pass through the earth for some feet and then open at the bottom of the cellar. If possible, the ventilator that carries the foul air off should be connected with a stove pipe in a room above, with its lower end reaching to the bottom of the cellar. The College apiary cellar is grouted throughout, which makes it more dry and neat. Of course it should be thoroughly drained.

The colonies should be put into the depository when the hives are dry, *before cold weather*, and should remain till April; though in January and March, if there are days that are warm, they should be taken out and the bees permitted to fly, though not unless they seem uneasy and soil the entrance to their hives. *Always* when taken out they should be placed on their old stands, so that no bees may be lost. Towards night, when all are quiet, return them to the cellar. I would not remove bees till towards

night, as it is better that they have a good flight, and then become quiet. When moved out it is *very* desirable to brush away all dead bees which is an argument in favor of a movable bottom-board. In moving the hives, great care should be exercised not to jar them. It were better if the bees should not know that they were being moved at all.

That the moisture may be absorbed, I cover the bees with a quilt, made of coarse factory cloth, enclosing a layer of cotton batting. Above this I fill in with straw which is packed in so closely that the cover may be removed without the straw falling out. If desirable the straw may be cut—or chaff may be used—and may be confined in a bag made of factory, so that it resembles a pillow. I now use these and like them. This is not only an excellent absorbent, but preserves the heat, and may well remain, till the following June.

I have found it advantageous, when preparing my bees for winter, in October, to contract the chamber by use of a division board. This is very desirable if wintered out doors, and with frames a foot square is very easily accomplished. By use of eight frames the space (one cubic foot) is very compact, and serves to economize the heat, not only in winter, but in spring. By thus using a division board with only three frames, I have been very successful in wintering nuclei. We have only to guard against low temperature.

Perhaps I ought to say that all colonies should be strong in autumn ; but I have said before, never have weak colonies. Yet for fear some have been negligent, I remark that weak colonies should be united in preparing for winter. To do this, approximate the colonies each day four or five feet till they are side by side. Now remove the poorest queen, then smoke thoroughly, sprinkle both colonies with sweetened water scented with essence of peppermint, putting a sufficient number of the best frames and all the bees into one of the hives, and then set this midway between the position of the hives at the commencement of the uniting. The bees will unite peaceably, and make a strong colony. Uniting colonies may pay at other seasons. It may seem rash to some, yet I fully believe that if the above suggestions are carried out in full, I may guarantee successful wintering. But if we do lose our bees—

with all our hives, combs and honey, we can buy colonies in the spring, with a perfect certainty of making 200 or 300 per cent. on our investment. Even with the worst condition of things, we are still ahead, in way of profit, of most other vocations.

BURYING BEES.

Another way to winter safely and very economically, is to bury the bees. If this is practiced the ground should either be sandy or *well drained.* If we can choose a side-hill it should be done. Beneath the hives and around them, straw should be placed. I should advise leaving the entrance well open, yet secure against mice. *The hives should all be placed beneath the surface* level of the earth, then form a mound above them sufficient to preserve against extreme warmth or cold. A trench about the mound to carry the water off quickly is desirable. In this arrangement the ground acts as a moderator. Five colonies thus treated the past winter, (1877–8) lost all told less than one-half gill of bees. As this method has not been so long tried, as the others, I would suggest caution. Try it with a few colonies, till you are assured as to the best arrangement, and of its efficacy. I am inclined to think that it is next to a good snow-bank, as a winter repository.

SPRING DWINDLING.

As already suggested, this is not to be feared if we keep our bees breeding till late autumn. It may be further prevented by forbidding late autumn flights, frequent flights in winter, when the weather is warm, and too early flying in spring. These may all be curtailed or prevented by the packing system as described above, as thus prepared the bees will not feel the warmth, and so will remain quiet in the hive. Nine colonies which I have packed have been remarkably quiet, and are in excellent condition this, February 25th, while two others unpacked have flown day after day, much, I fear, to their injury. I would leave bees in the packing till near May, and in the cellar or ground, till early flowers bloom, that we may secure against too rapid demise of bees in spring.

CHAPTER XVIII.

THE HOUSE APIARY.

DESCRIPTION.

This is a double-walled house, which may be rectangular or octagonal in form. The outer wall should be of brick, and made as thin as possible. Inside of this there should be wooden strips two-inches thick, which should receive a layer of paper-sheeting inside, which may be held by nailing strips two-inches wide immediately inside the first mentioned strips. These last strips should receive lath, after which all should be plastered. This may cost more than a purely wooden structure, but it will be more nearly frost-proof than any other kind of wall, and in the end will be the cheapest. There will be two dead air-chambers, each two inches deep, one between the paper and brick, the other between the paper and the plaster. The entire wall will be at least eight inches thick. If desired, it may be made less thick by using one-inch strips, though for our very severe winters the above is none too thick. The doors and windows should be double and should all shut closely against rubber. The outer ones should consist of glass, and should be so hung as to swing out, and in hot weather should be replaced with door, and window-screens, of coarse, painted, wire gauze. A small window just above each colony of bees is quite desirable.

Somewhere in the walls there should be a ventilating tube —a brick flue would be very good—which should open into the room just above the floor. Above it might open into the attic, which should be well aired. Ventilators such as are so common on barns might be used.

The pipe for admitting air, should, as in the cellar before described, pass through the ground and enter the floor from below. A good cellar, well ventilated and thoroughly dry will be convenient, and should not be neglected. I would have the building but one story, with joists in ceiling above

eight inches thick. Above these I would sheet with building paper, fastened by nailing strips two inches deep on top, above which I would ceil with matched boards. I should lath and plaster below the joists. The hives, which are to be kept constantly in this house, may rest on two rows of shelves, one at the floor, the other three feet high, and should be arranged for both top and side storing in the small section frames. Indeed, the hive need only consist of the two rabbeted side-boards (Fig. 30, *c*), and a division-board with quilt. The entrances of course pass through the wall. An alighting-board, so hinged as to be let down in summer, but tightly closed over the entrance during very severe winter weather, I should think would be very desirable. Between the double windows, which it will be remembered shut closely against rubber, sacks of chaff may be placed in winter, if found necessary to keep the proper temperature. With few colonies this might be very necessary. The adjacent entrances should vary in color, so that young queens would not go estray, when they returned from their "marriage flight."

ARE THEY DESIRABLE?

As yet, I think this question cannot be answered. Some who have tried them, among whom are Messrs. Russell and Heddon, of this State, pronounce against them. Perhaps they have faulty houses, perhaps they have had too brief an experience to judge correctly. Others, among whom are Messrs. A. I. Root, Burch, and Nellis, have tried them, and are loud in their favor. I think these first trials are hardly conclusive, as perfection seldom comes in any system with the first experience. That the early use of these houses has met with so much favor, seems to argue that with more experience, and greater perfection, they may become popular. Yet I would urge people to be slow to adopt these costly houses, as enough will do so to thoroughly test the matter; when, if they prove a desideratum, all can build; whereas, if they prove worthless, we shall not have to regret money squandered, in the adoption of what was of doubtful value.

THE CASE AS IT NOW STANDS.

The desirable points as they now appear, are: First. The bees are in condition to winter with no trouble or anxiety.

Second. The bees are handled in the house, and as they fly at once to the windows, where they can be suffered to escape, they are very easily and safely handled, even with little or no protection. Third. As we can extract, manipulate honey boxes, etc., right in the same house, it is desirable on the score of convenience. Fourth. As the bees are protected from the sudden rise of the out-door temperature, they will be kept from frequent flights during the cold, forbidding days of fall, winter and spring, and will thus be more secure against spring dwindling. Fifth. As the bees are so independent of out-door heat, because of the thick walls, with intervening air-spaces, they are found less inclined to swarm. Sixth. We can lock our house, and know that thieves cannot steal our hard-earned property.

The objections to them are : First. The bees leave the hives while being handled, crawl about the house, from which it is difficult to dislodge them, especially the young bees. This objection may disappear with improved houses and practice. Second. In very severe winters, like that of 1874 and 1875, they may not offer sufficient protection, yet they would be much safer than chaff hives, as there would be many colonies all mutually helping each other to maintain the requisite temperature, and the walls might be even thicker than specified above, without any serious inconvenience. Third. Some think it pleasanter and more desirable to handle bees out-doors, where all is unconfined. Fourth. The cost of the house ; yet this is only for once in a life-time, and saves providing shade, sawdust, packing-boxes, complex hives, etc.

So, we see the question is too complex to be settled except by careful experiment, and this, too, for a series of years. There are so many now in use in the various States, that the question must soon be settled. I predict that these structures will grow more and more into favor.

CHAPTER XIX.

EVILS THAT CONFRONT THE APIARIST.

There are various dangers that are likely to vex the apiarist, and even to stand in the way of successful apiculture.—Yet, with knowledge, most, if not all of these evils may be wholly vanquished. Among these are: Robbing among the bees, disease, and depredations from other animals.

ROBBING.

This is a trouble that often very greatly annoys the inexperienced. Bees only rob at such times as the general scarcity of nectar forbids honest gains. When the question comes: Famine or theft, like many another, they are not slow to choose the latter. It is often induced by working with the bees at such times, especially if honey is scattered about or left lying around the apiary. It is especially to be feared in spring, when colonies are apt to be weak in both honey and bees, and thus are unable to protect their own meager stores. The remedies for this evil are not far to seek:

First. Strong colonies are *very rarely* molested, and are almost sure to defend themselves against marauders; hence, it is only the weaklings of the apiarist's flock that are in danger. Therefore, regard for our motto, "Keep all colonies strong," will secure against harm from this cause.

Second. Italians, as before stated, are fully able, and quite as ready, to protect their rights against neighboring tramps. Woe be to the thieving bee that dares to violate the sacred rights of the home of our beautiful Italians. For such temerity is almost sure to cost the intruder its life.

But weak colonies, like our nuclei, and those too of black bees, are still easily kept from harm. Usually, the closing of the entrance so that but a single bee can pass through, is

all sufficient. With the hive we have recommended, this is easily accomplished by simply moving the hive back.

Another way to secure such colonies against robbing is to move them into the cellar for a few days. This is a further advantage, as less food is eaten, and the strength of the individual bees is conserved by the quiet, and as there is no nectar in the fields no loss is suffered.

In all the work of the apiary at times of no honey gathering, we cannot be too careful to keep all honey from the bees unless placed in the hives. The hives, too, should not be kept open long at a time. Neat, quick work should be the watch-word. During times when robbers are essaying to practice their nefarious designs, the bees are likely to be more than usually irritable, and likely to resent intrusion; hence the importance of more than usual caution, if it is desired to introduce a queen.

DISEASE.

The common dysentery—indicated by the bees soiling their hives, as they void their feces within instead of without—which has been so free, of late, to work havoc in our apiaries, is, without doubt, I think, consequent upon wrong management on the part of the apiarist, as already suggested in Chapter XVII. As the methods to prevent this have already been sufficiently considered, we pass to the terrible

FOUL BROOD.

This disease, said to have been known to Aristotle—though this is doubtful, as a stench attends common dysentery—though it has occurred in our State as well as in States about us, is not familiar to me, I having never seen but one case, and that on Kelly's Island, in the summer of 1875, where I found it had reduced the colonies on that Island to two. No bee malady can compare with this in malignancy. By it Dzierzon once lost his whole apiary of 500 colonies.—Mr. E. Rood, first President of the Michigan Association, has lost his bees two or three times by this same terrible plague.

The symptoms are as follows: Decline in the prosperity of the colony, because of failure to rear brood. The brood seems to putrefy, becomes "brown and salvy," and gives off a

stench, which is by no means agreeable, while later, the caps are concave instead of convex, and have a little hole through them.

There is no longer any doubt as to the cause of this fearful plague. Like the fell "Pebrine," which came so near exterminating the "silk worm," and a most lucrative and extensive industry in Europe, it, as conclusively shown by Drs. Preusz and Shönfeld, of Germany, is the result of fungus, or vegetable growth. Shönfeld not only infected healthy bee larvæ, but those of other insects, both by means of the putrescent foul brood, and by taking the spores.

Fungoid growths are very minute, and the spores are so infinitesimally small as often to elude the sharp detection of the expert microscopist. Most of the terrible, contagious diseases that human flesh is heir to, like typhus, diphtheria, cholera, small pox, &c., &c., are now thought to be due to microscopic germs, and hence to be spread from home to home, and from hamlet to hamlet, it is only necessary that the spores, the minute seeds, either by contact or by some sustaining air current, be brought to new soil of flesh blood or other tissue—their garden spot—when they at once spring into growth, and thus lick up the very vitality of their victims. The huge mushroom will grow in a night. So too, these other plants—the disease germs—will develop with marvelous rapidity; and hence the horrors of yellow fever, scarletina, and cholera.

To cure such diseases, the fungi must be killed. To prevent their spread, the spores must be destroyed, or else confined. But as these are so small, so light, and so invisible—easily borne and wafted by the slightest zephyr of summer, this is often a matter of the utmost difficulty.

In "Foul Brood" these germs feed on the larvæ of the bees, and thus convert life and vigor into death and decay. If we can kill this miniature forest of the hive, and destroy the spores, we shall extirpate the terrible plague.

REMEDIES.

If we can find a substance that will prove fatal to the fungi, and yet not injure the bees, the problem is solved. Our German scientists—those masters in scientific research

and discovery, have found this valuable fungicide in salicylic acid, an extract from the same willows that give us pollen and nectar. This cheap white powder is easily soluble in alcohol, and when mixed with borax in water.

Mr. Hilbert, one of the most thoughtful of German bee-keepers, was the first to effect a radical cure of foul brood in his apiary by the use of this substance. He dissolved fifty grains of the acid in five hundred grains of pure spirits. One drop of this in a grain of distilled water is the mixture he applied. Mr. C. F. Muth, from whom the above facts as to Herr Hilbert are gathered, suggests a variation in the mixture.

Mr. Muth suggests an improvement, which takes advantage of the fact that the acid, which alone is very insoluble in water, is, when mixed with borax, soluble. His recipe is as follows: One hundred and twenty-eight grains of salicylic acid, one hundred and twenty-eight grains of soda borax, and sixteen ounces distilled water. There is no reason why water without distillation should not do as well.

This remedy is applied as follows: First uncap all the brood, then throw the fluid over the comb in a fine spray. This will not injure the bees, but will prove fatal to the fungi.

If the bees are removed to an empty hive, and given no comb for three or four days, till they have digested all the honey in their stomachs, and then prevented visiting the affected hive, they are said to be out of danger. It would seem that the spores are in the honey, and by taking that, the contagion is administered to the young bees. The honey may be purified from these noxious germs, by subjecting it to the boiling temperature, which is generally, if not always, fatal to the spores of fungoid life. By immersing the combs in a salicylic acid solution, or sprinkling them with the same, they would be rendered sterile, and could be used without much fear of spreading contagion. The disease is probably spread by robber bees visiting affected hives, and carrying with them in the honey the fatal germs.

I have found that a paste made of gum ot tragacanth and water is very superior, and I much prefer it for either general or special use to gum of Arabic. Yet it soon sours —which means that it is nourishing these fungoid plants—

and thus becomes disagreeable. I have found that a very little salicylic acid will render it sterile, and thus preserve it indefinitely.

ENEMIES OF BEES.

Swift was no mean entomologist, as shown in the following stanza:

"The little fleas that do us tease,
Have lesser fleas to bite them,
And these again have lesser fleas,
And so ad infinitum,"

Bees are no exception to this law, as they have to brave the attacks of reptiles, birds, and other insects. In fact, they are beset with perils at home, and perils abroad, perils by night and perils by day.

THE BEE MOTH—*Galleria Cereana*, Fabr.

This insect belongs to the family of snout moths, Pyralidæ. This snout is not the tongue, but the palpi, which fact was not known by Mr. Langstroth, who is usually so

FIG. 102.

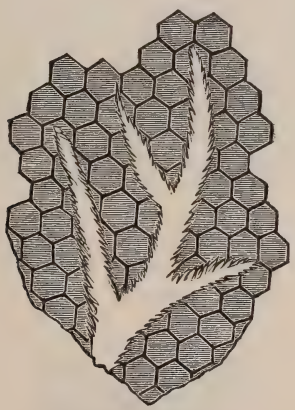


accurate, as he essayed to correct Dr. Harris, who stated correctly, that the tongue, the ligula, was "very short and hardly visible." This family includes the destructive hop

moth, and the noxious meal and clover moths, and its members are very readily recognized by their unusually long palpi, the so-called snouts.

The eggs of the bee moth are white, globular and very small. These are usually pushed into crevices by the female moth as she extrudes them, which she can easily do by aid of her spy-glass-like ovipositor. They may be laid in the hive, in the crevice underneath it or about the entrance.—Soon these eggs hatch, when the gray, dirty looking caterpillars, with brown heads, seek the comb on which they feed. To better protect themselves from the bees, they wrap themselves in a silken tube (Fig. 102) which they have power to spin. They remain in this tunnel of silk during all their growth, enlarging it as they eat. By looking closely, the presence of these larvæ may be known by this robe of glistening silk, as it extends in branching outlines (Fig. 103) along the surface of the comb. A more speedy detection,

FIG. 103.



even, than the defaced comb, comes from the particles of comb, intermingled with the powder-like droppings of the caterpillars, which will always be seen on the bottom-board in case the moth-larvæ are at work. Soon, in three or four weeks, the larvæ are full grown (Fig. 104). Now the six

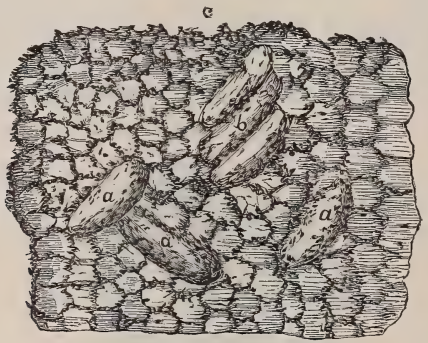
jointed, and the ten prop-legs—making sixteen in all, the usual number of caterpillars—are plainly visible. These larvæ are about an inch long, and show, by their plump appearance,

FIG. 104.



that *they at least*, can digest comb. They now spin their cocoons, either in some crevice about the hive, or, if very numerous, singly (Fig. 105, *a*) or in clusters (Fig. 105, *b*) on the comb, or even in the drone-cells (Fig. 105, *c*) in which they

FIG. 105.



become pupæ, and in two weeks, even less, sometimes, during the extreme heat of summer, the moths again appear. In winter, they may remain as pupæ for months. The moths or

FIG. 106.



millers—sometimes incorrectly called moth-millers—are of an obscure gray color, and thus so mimic old boards, that they

are very readily passed unobserved by the apiarist. They are about three-fourths of an inch long, and expand (Fig. 106) nearly one and one-fourth inches. The females (Fig. 107) are darker than the males (Fig. 107), possess a longer snout, and are usually a little larger. The wings, when the moths are quiet (Fig. 107) are flat on the back for a narrow space, then slope very abruptly. They rest by day, yet, when disturbed, will dart forth with great swiftness, so Réuamur styled them "nimble-footed." They are active by night, when they essay

FIG. 107.



Male. *Female.*

to enter the hive and deposit their one or two hundred eggs. If the females are held in the hand they will often extrude their eggs; in fact, they have been known to do this even after the head and thorax were severed from the abdomen, and still more strange, while the latter was being dissected.

It is generally stated that these are two-brooded, the first moths occurring in May, the second in August. Yet, as I have seen these moths in every month from May to September, and as I have proved by actual observation that they may pass from egg to moth in less than six weeks. I think under favorable conditions there may be even three broods a year. It is true that the varied conditions of temperature—as the moth larvæ may grow in a deserted hive, in one with few bees, or one crowded with bee life—will have much to do with the rapidity of development. Circumstances may so retard growth and development that there may not be more than two, and possibly, in extreme cases, more than one brood in a season.

It is stated by Mr Quinby that a freezing temperature will kill these insects in all stages, while Mr. Betsinger thinks that a deserted hive is safe, neither of which assertions are correct. I have seen hives, whose bees were killed by the

severe winter, crowded with moth pupæ or chrysalids the succeeding summer. I have subjected both larvæ and pupæ to the freezing temperature without injuring them. I believe, in very mild winters, the moth and the chrysalids might be so protected as to escape unharmed, even outside the hive. It is probable too, that the insects may pass the winter in any one of the various stages.

HISTORY.

These moths were known to writers of antiquity, as even Aristotle tells of their injuries. They are wholly of oriental origin, and are often referred to by European writers as a terrible pest. Dr. Kirtland, the able scientist, the first President of our American Bee Convention, whose decease we have just had to mourn, once said in a letter to Mr. Langstroth, that the moth was first introduced into America in 1805, though bees had been introduced long before. They first seemed to be very destructive. It is quite probable, as has been suggested, that the bees had to learn to fear and repel them; for, unquestionably, bees do grow in wisdom.—In fact, may not the whole of instinct be inherited knowledge, which once had to be acquired by the animal. Surely bees and other animals learn to battle new enemies, and vary their habits with changed conditions, and they also transmit this knowledge and their acquired habits to their offspring, as illustrated by setter and pointer dogs. In time, may not this account for all those varied actions, usually ascribed to instinct? At least, I believe the bee to be a creature of no small intelligence.

REMEDIES.

In Europe, late writers give very little space to this moth. Once a serious pest, it has now ceased to alarm, or even disquiet the intelligent apiarist. In fact, we may almost call it a blessed evil, as it will destroy the bees of the heedless, and thus prevent injury to the markets by their unsaable honey, while to the attentive bee-keeper it will work no injury at all. Neglect and ignorance are the moth breeders.

As already stated, Italian bees are rarely injured by moths, and strong colonies never. As the enterprising apiarist will only possess these, it is clear that he is free from

danger. The intelligent apiarist will also provide, not only against weak, but queenless colonies as well, which from their abject discouragement, are the surest victims to moth invasion. Knowing that destruction is sure, they seem, if not to court death, to make no effort to delay it.

In working with bees, an occasional web will be seen glistening in the comb, which should be picked out with a knife till the manufacturer—the ruthless larva—is found, when it should be crushed. Any larva seen about the bottom board, seeking a place to spin its cocoon, or any pupæ, either on comb or in crack, should also be killed. If, through carelessness, a colony has become hopelessly victimized by these filthy, stinking, wax devourers, then the bees and any combs not attacked should be transferred to another hive, after which the old hive should be sulphured by use of the smoker, as before described (page 216), then by giving one or two each of the remaining combs to strong colonies, after killing any pupæ that may be on them, they will be cleaned and used, while by giving the enfeebled colony brood, if it has any vigor remaining, and if necessary a good queen, they will soon be rejoicing in strength and prosperity.

We have already spoken of caution as to comb honey and frames of comb (page 216), and so need not speak further of them.

BEE KILLER—*Asilus Missouriensis*, Riley.

This is a two-winged fly, of the predacious family Asilidæ, which attacks, and takes captive the bee and then feeds upon its fluids. It is confined to the southern part of our country.

The fly (Fig. 108) has a long, pointed abdomen, strong wings, and is very powerful. I have seen an allied species attack and overcome the powerful tiger-beetle, whereupon I took them both with my net, and now have them pinned, as they were captured, in our College cabinet. These flies delight in the warm sunshine, are very quick on the wing, and are thus not easily captured. It is to be hoped that they will not become very numerous. If they should, I hardly know how they could be kept from their evil work. Frightening them, or catching with a net might be tried, yet these methods would irritate the bees, and need to be tried before

they are recommended. I have received specimens of this fly from nearly every Southern State. There are very similar flies North, belonging to the same genus, but as yet we have

FIG. 108.

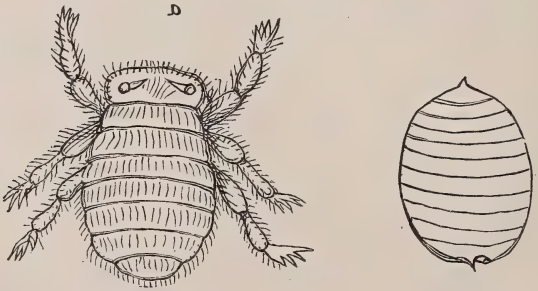


no account of their attacking bees, though such a habit might easily be acquired, and attacks here would not be surprising.

BEE-LOUSE—*Branla Cœca*, Nitsch.

This louse (Fig. 109) is a wingless Dipteron, and one of the uniques among insects. It is a blind, spider-like parasite, and serves as a very good connecting link between insects

FIG. 109.



Imago. *Larva.*

and spiders, or, still better, between the Diptera, where it belongs, and the Hemiptera, which contains the bugs and

most of the lice. It assumes the semi-pupa state almost as soon as hatched, and strangest of all, is, considering the size of the bee on which it lives, and from which it sucks its nourishment, enormously large. Two or three, and sometimes even more, (the new Encyclopedia Britanica says 50 or 100), are often found on a single bee. When we consider their great size we cannot wonder that they very soon devitalize the bees.

These, as yet, have done little damage, except in the south of Continental Europe. The fact that they have not become naturalized in the northern part of the Continent, England or America, would go to show that there is something inimical to their welfare in our climate, especially as they are constantly being introduced, coming as hangers-on to our imported bees. Within a year I have received them from no less than three sources—twice from New York and once from Pennsylvania—each time taken from bees just received from Italy. The only way that I could suggest to rid bees of them would be to make the entrance to the hive small, so that as the bees enter, they would be scraped off. On the bee they are not unlike a tall hat on a small boy. I would rid the bees of the lice as I would the boy of his hat, by bidding him run under the table.

IMPORTANT SUGGESTION.

In view of the serious nature of this pest and the difficulty in the way of its extinction, I would urge importers, and people receiving imported queens, to be very careful to see that these lice, which, from their size, are so easily discovered, are surely removed before any queen harboring them is introduced. This advice is especially important, in view of the similarity in climate of our own beautiful South, to the sunny slopes of France and Italy. Very likely the lice could not flourish in our Southern States, but there would be great cause to fear the results of its introduction into our Eldorado, the genial States of the West. In California, they might be even worse than the drouth, as they might come as a permanent, not a temporary evil.

BEE HAWK—*Libellula.*

This large, fine lace wing is a neuropterous insect. It works in the Southern States and is called Mosquito-hawk.—

Insects of the same genus are called dragon flies, devil's darning-needles, &c. These are exceedingly predacious. In fact, the whole sub-order is insectivorous. From its four netted, veined wings, we can tell it at once from the asilus before mentioned, which has but two wings. The Bee or Mosquito-hawk is resplendent with metalic green, while the Bee Killer is of sober gray. The Mosquito Hawk is not inaptly named, as it not only preys on other insects, swooping down upon them with the dexterity of a hawk, but its graceful gyrations, as it sports in the warm sunshine at noonday, are not unlike those of our graceful hawks and falcons. These insects are found most abundant near water, as they lay their eggs in water, where the larvæ live and feed upon other animals. The larvæ are peculiar in breathing by gills in their rectum. The same water that bathes these organs and furnishes oxygen, is sent out in a jet, and thus sends the insect darting along. The larvæ also possess enormous jaws, which formidable weapons are masked till it is desired to use them, when the dipper-shaped mask is dropped or unhinged and the terrible jaws open and close upon the unsuspecting victim, which has but a brief time to bewail its temerity.

A writer from Georgia, in *Gleanings*, volume 6, page 35, states that these destroyers are easily scared away, or brought down by boys with whips, who soon become as expert in capturing the insects, as are the latter in seizing the bees. The insects are very wild and wary, and I should suppose this method would be very efficient.

TACHINA FLY.

From descriptions which I have received, I feel certain

FIG. 110.



that there is a two-winged fly, probably of the genus Tachina

(Fig. 110), that works on bees. I have never seen these, though I have repeatedly requested those who have, to send them to me. My friend, Mr. J. L. Davis, put some sick looking bees into a cage, and hatched the flies which he told me looked not unlike a small house fly. It is the habit of these flies, which belong to the same family as our house flies, which they much resemble, to lay their eggs on other insects. Their young, upon hatching, burrow into the insect that is being victimized, and grows by eating it. It would be difficult to cope with this evil, should it become of great magnitude. We may well hope that this habit of eating bees is an exceptional one with it.

SPIDERS.

These sometimes spread their nets so as to capture bees. If porticoes—which are, I think, worse than a useless expense—are omitted, there will very seldom be any cause for complaints against the spiders, which on the whole are friends. As the bee-keeper who will permit spiders to worry his bees would not read books, I will discuss this subject no further.

ANTS.

These cluster about the hives in spring for warmth, and seldom, if ever, I think, do any harm. Should the apiarist feel nervous, he can very readily brush them away, or destroy them by use of any of the fly poisons which are kept in the markets. As these poisons are made attractive by adding sweets, we must be careful to preclude the bees from gaining access to them. As we should use them in spring, and as we then need to keep the quilt or honey-board close above the bees, and as the ants cluster above the brood chamber, it is not difficult to practice poisoning. One year I tried Paris green with perfect success.

WASPS.

I have never seen bees injured by wasps. In the South, as in Europe, we hear of such depredations. I have received wasps, sent by our southern brothers, which were caught destroying bees. The wasps are very predacious, and do

immense benefit by capturing and eating our insect pests. I have seen wasps carry off "currant-worms" with a celerity that was most refreshing.

As the solitary wasps are too few in numbers to do much damage—even if they ever do any—any great damage which may occur would doubtless come from the social paper-makers. In this case, we have only to find the nests and apply the torch, or hold the muzzle of a shot-gun to the nest and shoot. This should be done at nightfall when the wasps have all gathered home. Let us not forget that the wasps do much good, and so not practice wholesale slaughter unless we have strong evidence against them.

THE KING BIRD—*Tyrannus Carolinensis.*

This bird, often called the bee-martin, is one of the fly-catchers, a very valuable family of birds, as they are wholly insectivorous, and do immense good by destroying our insect pests. The king bird is the only one of them in the United States that deserves censure. Another, the chimney swallow of Europe, has the same evil habit. Our chimney swallow has no evil ways. I am sure, from personal observation, that these birds capture and eat the workers, as well as drones; and I dare say, they would pay no more respect to the finest Italian Queen. Yet, in view of the good that these birds do, unless they are far more numerous and troublesome than I have ever observed them to be, I should certainly be slow to recommend the death warrant.

THE TOADS.

The same may be said of the toads, which may often be seen sitting demurely at the entrance of the hives, and lapping up the full-laden bees with the lightning-like movement of their tongues, in a manner which can but be regarded with interest, even by him who suffers loss. Mr. Moon, the well known apiarist, made this an objection to low hives; yet, the advantage of such hives far more than compensates, and with a bottom-board, such as described in the chapter on hives, we shall find that the toads do very little damage.

MICE.

These little pests are a consummate nuisance about the

apiary. They enter the hives in winter, mutilate the comb, irritate the bees, and create a very offensive stench. They often greatly injure comb which is outside the hive, destroy smokers by eating the leather off the bellows, and if they get at the seeds of honey plants, they never retreat till they make a complete work of destruction.

In the house and cellar, these plagues should be, by use of cat or trap, completely exterminated. If we winter on the summer stands, the entrance should be so contracted that mice can not enter the hive. In case of packing as I have recommended, I should prefer a more ample opening, which may be safely secured by taking a piece of wire cloth or perforated tin, and tacking it over the entrance, letting it come within one-fourth of an inch of the bottom board. This will give more air, and still preclude the entrance of these miserable vermin.

CHAPTER XX.

CALENDAR AND AXIOMS.

WORK FOR DIFFERENT MONTHS.

Though every live apiarist will take one, at least, of the three excellent journals relating to this art, printed in our country, in which the necessary work of each month will be detailed, yet it may be well to give some brief hints in this place.

JANUARY.

During this month the bees will need little attention.—Should the bees in the cellar or depository become uneasy, which will not happen if the requisite precautions are taken, and there come a warm day, it were well to set them on their summer stands, that they may enjoy a purifying flight. At night when all are again quiet return them to the cellar.—While out I would clean the bottom-boards, especially if there are many dead bees. This is the time, too, to read, visit, study and plan for the ensuing season's work.

FEBRUARY.

No advice is necessary further than that given for January, though if the bees have a good fly in January, they will scarcely need attention in this month. The presence of snow on the ground need not deter the apiarist from giving his bees a flight, providing the day is warm and still. It is better to let them alone if they are quiet.

MARCH.

Bees should still be kept housed, and those outside still retain about them the packing of straw, shavings, &c. Frequent flights do no good, and wear out the bees. Colonies that are uneasy, and besmear their hives should be set out, and allowed a good flight and then returned.

The colony or colonies from which we desire to rear queens and drones should now be fed, to stimulate breeding. By careful pruning, too, we may and should prevent the rearing of drones in any but the best colonies. If from lack of care the previous autumn, any of our stocks are short of stores, now is when it will be felt. In such cases feed either honey, sugar, syrup, or place candy on top of the frames beneath the quilt.

APRIL.

Early in this month the bees may all be set out. It will be best to feed all, and give all access to flour, when they will work at it, though usually they can get pollen as soon as they can fly out to advantage. Keep the brood chamber contracted so that the frames will all be covered, and cover warm above the bees to economize heat.

MAY.

Prepare nuclei to start extra queens. Feed sparingly till bloom appears. Give room for storing. Extract if necessary, and keep close watch, that you may anticipate and forestall any attempt to swarm. Now, too, is the best time to transfer.

JUNE.

Keep all colonies supplied with vigorous, prolific queens. Divide the colonies, as may be desired, especially enough to prevent attempts at swarming. Extract if necessary or best; adjust frames or sections, if comb honey is desired, and be sure to keep all the white clover honey, in whatever form taken, separate from all other. Now is the best time to Italianize.

JULY.

The work this month is about the same as that of June.—Supersede all poor and feeble queens. Keep the basswood honey by itself, and remove boxes or frames as soon as full. Be sure that queens and workers have plenty of room to do their best, and suffer not the hot sun to strike the hives.

AUGUST.

Don't fail to supersede impotent queens. Between bass-

wood and fall bloom it may pay to feed sparingly. Give plenty of room for queen and workers as fall storing commences.

SEPTEMBER.

Remove all surplus boxes and frames as soon as storing ceases, which usually occurs about the middle of this month; feed sparingly till the first of October. If robbing occurs, contract the entrance of the hive robbed. If it is desired to feed honey or sugar for winter, it should be done the last of this month.

OCTOBER.

Prepare colonies for winter. See that all have at least thirty pounds, by weight, of good, capped honey, and that all are strong in bees. Contract the chamber, by using division board, and cover well with the quilt. Be sure that one or two central frames of comb contain many empty cells, and that all have a central hole through which the bees can pass.

NOVEMBER.

Before the cold days come, remove the bees to the cellar or depository, or pack about those left out on the summer stands.

DECEMBER.

Now is the time to make hives, honey-boxes, &c., for the coming year. Also labels for hives. These may just contain the name of the colony, in which case the full record will be kept in a book; or the label may be made to contain a full register as to time of formation, age of queen, &c., &c. Slates are also used for the same purpose.

I know from experience that any who heed all of the above may succeed in bee-keeping,—may win a double success:—Receive pleasure and make money. I feel sure that many experienced apiarists will find advice that it may pay to follow. It is probable that errors abound, and certain that much remains unsaid, for of all apiarists it is trûe that what they don't know is greatly in excess of what they do know.

AXIOMS.

The following axioms, given by Mr. Langstroth, are just as true to-day as they were when written by that noted author:

There are a few *first principles* in bee-keeping which ought to be as familiar to the Apiarist as the letters of the alphabet.

First. Bees gorged with honey never volunteer an attack.

Second. Bees may always be made peaceable by inducing them to accept of liquid sweets.

Third. Bees, when frightened by smoke or by drumming on their hives, fill themselves with honey and lose all disposition to sting, unless they are hurt.

Fourth. Bees dislike any *quick* movements about their hives, especially any motion which *jars* their combs.

Fifth. In districts where forage is abundant only for a short period, the largest yield of honey will be secured by a *very* moderate increase of stocks.

Sixth. A moderate increase of colonies in any one season, will, in the long run, prove to be the easiest, safest, and cheapest mode of managing bees.

Seventh. Queenless colonies, unless supplied with a queen, will inevitably dwindle away, or be destroyed by the bee-moth, or by robber-bees.

Eighth. The formation of new colonies should ordinarily be confined to the season when bees are *accumulating* honey; and if this, or any other operation must be performed, when forage is scarce, the greatest precautions should be used to prevent robbing.

The essence of all profitable bee-keeping is contained in Oettl's Golden Rule: KEEP YOUR STOCKS STRONG. If you cannot succeed in doing this, the more money you invest in bees, the heavier will be your losses; while, if your stocks are strong, you will show that you are a *bee-master*, as well as a bee-keeper, and may safely calculate on generous returns from your industrious subjects.

"*Keep all colonies strong.*"

GENERAL INDEX.

	PAGE.
A B C of Bee Culture	22
Abdomen of Insects	48
Air Tubes	28
Albino Bees	43
Alighting-Board	127
separate from bottom-board	127
Alsike Clover—see clover	228
American Bee Journal	19
Amateurs	11
Anatomy and Physiology	48
of bees	71
of insects	48
internal	56
Antennæ	51
Ants	271
remedies for	271
function	51
Apiary,	
where to locate	120
grounds	152
house—see house apiary	255
position of	152
Apiary Grounds	152
arrangement of	152
improvement of	153
screens for	152
shade for	153
Apiculture,	
adaptation to women	15
as an avocation	15
fascination of	12
for amateurs	11, 15
for specialists	11
inducements to	12
adaptation to women	15
excellence for amateurs	15
improves the mind	17
recreation	12
yields delicious food	17
profits of	13
requisites to	18
conventions	19
enthusiasm	24
experience	18
mental effort	18
persistence	24
prompt attention	23
publications	19
study and thought	18
visits to other apiarists	18
work	11
unsuited to whom	12
Apidæ Family	34
animals of	35
instincts of	34
Apis Genus	38
animals of	40
characters of	38
Apis Mellifica	41
Aristotle	44
Articulate Branch	27
animals of	27
Artificial Colonies	177
advantages of	177
how made	177
one from one	177
one from several	178
Axioms	277
Barberry	225
figure	226
Barnes' Saw	151
Basswood	237
figure of	237
Bees,	
as fertilizers	220
burying	254
how to procure	118
injuring fruit	220
kind to purchase	119
kinds in each colony	71
place in the animal kingdom	27
quieted	197
by jarring	198
by smoking	198
value of	120
when to purchase	119
who may keep	11
why keep	13
Bee-Bread—see pollen	111
Bee Dress for Ladies	197
Bee Enemies	262
ants	271
bee-hawk	269
bee-killer	267
bee-louse	268
bee-moth	262
king-bird	272
mice	272
spiders	271
tachina fly	270
toads	272
wasps	271
Bee Gloves	197
Bee Glue—see propolis	112
Bee Hawk	269
remedy for	270
Bee-Keepers' Axioms	277
Bee-Keepers' Magazine	21
Bee-Killer	267
figure of	268
remedies for	267
Bee-Louse	268
figure of	268
remedy for	269

PAGE.

BEE-MOTH 262
cocoons of 264
figure of 264
eggs of 263
figure of 264, 265
larva of 263
figure of 264
remedies 266
silk tube of 263
figure of 262, 263
BEE PLANTS—see plants 220
necessary to success 218
list of 221
BEE VEIL 196
figure of 196
BEES ANGERED 195, 201
by quick movements 195, 201
by sweat 201
BEES SUBDUED 197
BEESWAX 106
from what 106
how separated 211
BEGGAR-TICKS 244
BERGAMOT 238
BEVAN ON THE HONEY-BEE 22
BEVEL-GAUGE 126
figure of 126
BEVEL JOINTS 126
BIBLIOGRAPHY 44, 113
BINGHAM HIVE 140
figure of 140
BINGHAM SMOKER 199
figure of 199
BLACK BEES—see German bees 41
BLACKBERRIES 236
BLOOD OF INSECTS 57
BODY OF INSECTS 48
parts of 48
BOMBUS 35
BONESET 238
figure of 241
BONNET 45
BOOKS FOR THE APIARIST 21
A B C of Bee Culture 22
Bevan's Honey-Bee 22, 113
foreign 22
Gray's Botany 244
Huber 113
Hunter's Manual 23
King's Text-Book 52
Langstroth on the Honey-Bee 21
Neighbour's Apiary 23, 118
Quinby's Mysteries 22
BOOKS FOR THE ENTOMOLOGIST 47, 113
Duncan's Transformations of Insects 113
Kirby & Spence 47
Packard 47, 113
Westwood 47
Reports 47
Fitch 47
Harris 47
Riley 47
BORAGE 231
figure of 230
BOTTOM-BOARD 127
figure of 128
immovable 129
BOX HIVES 122
BOXES 142
Barker & Dicer 143
crate for 144
figure of 142, 143
Harbison 142

PAGE.

BOXES—continued.
figure of 143
Isham 142
figure of 143
position of 144
Russell 142
special support for 142
use 142
BOX HONEY 142
when to secure 215
where to keep 216
BRANCH 27
articulata 27
of the honey-bee 27
BREATHING OF INSECTS 59
BREATHING-MOUTHS 59
BUCKWHEAT 242
figure of 242
BUTTON-BALL 238
figure of 240

CAGES
for introducing queen 184
for shipping queen 186
figure of 187
CALENDAR 274
CARPENTER BEES 36
CATNIP 232, 240
CHAFF HIVES 251
CHRYSALIDS 69
CIRCULATORY SYSTEM 57
CLASS 28
insecta 28
of the honey-bee 28
CLEOME—see Rocky M't'n bee plant. 238
CLOVER 228
Alsike 228
figure of 229
sweet 228
figure of 230
white 228
figure of 228
CLUSTERING OUTSIDE THE HIVE 153
cause of 153
how prevented 153
adding room 176
extracting 188
shading 153
COCOONS 69
of bees 98
COLLEGE COURSE 118
COLONIES,
always strong 119
how moved 187
COLUMELLA 44
COMB 108
cells in 110
worker 110
drone 110
figure of 109
for guide 208
how fastened 157, 158
how made 108, 110
transparency of 110
use of 110
what determines kind 110
COMB FOUNDATION 203
American 204
figure of 203
history of 203
how cut 207
how fastened 209
how made 206
use of 207

PAGE.

COMB FOUNDATION MACHINE 205
figure of 205
inventor of 205
COMB HONEY 215
apparatus to secure 141
care of 216
in boxes 142
in frames 144
in what form 144, 215
marketing 215
when to secure 215
CONVENTIONS 19
CORN 235
COTTON 236
figure of 236
COVER FOR FRAMES 136
COVER FOR HIVES 129
figure of 130, 131
CRATES,
section 149
market 216
CYPRIAN BEE 43

DE GEER 45
DIGESTIVE ORGANS 60
DISEASES 259
dysentery 247, 259
foul brood 259
DISSECTION 50, 65
DISSECTING INSTRUMENTS 51, 65
lenses 51, 65
needle points 51
dividers—see separators 146
DIVIDING COLONIES—see artificial colonies 171, 177
DIVISION-BOARD 137
figure of 137
use of 138
DOLLAR QUEENS 186
DORSATA BEE 40
DRESS FOR LADIES 197
DRONES 86
development of 87
eggs of 87
eyes of 86
function of 88
influence of, on drone progeny 89
jaws of 86
figure of 92
leg of 86
figure of 87
longevity of 88
number of 86
tongue of 86
when in hive 86, 88
why so numerous 89
DYSENTERY 247, 259

EGG 67
of insects 67
of bee 96
EGYPTIAN BEE 43
EMPTY CELLS 188
importance of 188
how to secure 188
ENTRANCE TO HIVE 128
EPICRANIUM 48
EXTRACTOR,
of honey 188
figure of 189
Everett's 190
history of 188

PAGE.

EXTRACTOR—continued.
how to use 194
knives for 191
figure of 191
rack for 189
figure of 190
use of 191
when to use 192
wire comb baskets for 189
figure of 189
of wax 212
figure of 212
EXTRACTED HONEY 214
market for 214
EXTRACTING HONEY 191
how done 194
why done 191
when done 192
EYES OF INSECTS 53
compound 54
simple 54

FABRICIUS 46
FAMILY 34
apidæ 34
of the honey-bee 34
FEEDER 160
figure of 160, 161
FEEDING 159
amount to feed 159
use of 159
what to feed 160
honey 160
sugar 160
flour 163
FEMALE ORGANS 64
FERTILE WORKERS 77
FERTILIZATION OF FLOWERS BY BEES 220
FIGWORT 238
figure of 238
FITCH'S REPORT 47
FOOT-POWER SAW 151
FOUL BROOD 259
cause 260
cure for 260
symptoms of 259
FOUNDATION 203
figure of 203
history of 203
use of 203, 207
how cut 207
how fastened 209
how made 206
FRAMES 132
arrangement for surplus 147
block for making 134
figure of 135
cover for 136
figure of 133, 134
form of 132
Gallup 133
gauge for construction 135
figure of 135
inventor of 123
Langstroth 132
number of 132
section 148
small—see sections 144
space about 136
space between 136
FRUIT TREES 225

PAGE.

GALLUP FRAME..... 133
GEOFFROY..... 45
GENUS,
apis..... 38
of the honey-bee..... 38
GERMAN OR BLACK BEE..... 31
GLEANINGS IN BEE CULTURE..... 20
GLOVES..... 197
GOLDEN-ROD..... 242
figure of..... 243
GRAPES INJURED BY BEES..... 220
GRAPE VINES FOR SHADE..... 153
GUNTHER..... 12

HANDLING BEES..... 195
HARRIS' INJURIOUS INSECTS..... 47
HARVEY..... 44
HEAD OF INSECTS..... 48
organs of..... 48
HEART OF INSECTS..... 57
HEXAPODS—see Insects..... 30
HIVES..... 122
alighting-board of..... 127
Bingham..... 140
figure of..... 140
bottom-board of..... 127
figure of..... 128
box not good..... 122
chaff..... 251
cover of..... 129
division-board for..... 137
entrance to..... 128
figure of..... 124, 130, 155
frames for..... 132
Huber..... 133
joints of..... 126
square..... 126
figure of..... 125
bevel..... 126
figure of..... 130
Langstroth..... 123
figure of..... 124
lumber for..... 124
movable comb..... 123
movable frame..... 122
near the ground..... 128
nucleus..... 165
position of..... 154
figure of..... 115
Quinby..... 139
figure of..... 139
rabbet of..... 125
size of..... 124
HONEY..... 104
collected, not secreted..... 104
defined..... 104
extracted..... 193
for food..... 17
granulated, how dissolved..... 193
how collected..... 105
how deposited..... 105
how transported..... 105
marketing of..... 213
natural use of..... 106
source of..... 105
bark lice..... 105, 218
honey-dew..... 105, 219
plants..... 105, 220
plant lice..... 105, 218
other sources..... 105, 219
HONEY-COMB—see comb..... 108
HONEY EXTRACTOR—see extractor.. 188
figure of..... 189

PAGE.

HONEY EXTRACTOR—continued.
importance of..... 188
requisites of..... 189
use of..... 191
when to use..... 192
HONEY KNIVES..... 191
figure of..... 191
HONEY PLANTS—see plants..... 218
for April..... 223
for May..... 225
for July..... 237
for June..... 228
for August..... 242
importance of..... 218
list of..... 221
HOUSE APIARY..... 255
advantages of..... 256
are they desirable?..... 256
objections to..... 257
HUBER..... 71
HUBER HIVE..... 133
kinds of..... 138
HUNTER'S MANUAL..... 23
HYMENOPTEROUS INSECTS..... 31
the highest..... 32
parasitic..... 32

IMAGO..... 70
INSECTA..... 28
animals of..... 30
class..... 28
INSECTS, or HEXAPODS..... 30
abdomen of..... 30
head of..... 30
imago of..... 30
larva of..... 30
pupa of..... 30
thorax of..... 30
transformations of..... 66
transformations, complete..... 66
transformations, incomplete..... 70
INTRODUCTION OF CELL..... 185
figure of..... 167
INTRODUCTION OF QUEEN..... 183
INTESTINES..... 61
ITALIAN BEES..... 41, 180
description of..... 42, 181
figure of..... Frontispiece
history of..... 41
superiority of..... 181

JAWS..... 50
figure of..... 92
JUDAS TREE..... 225
figure of..... 224

KING BIRD..... 272
KING'S TEXT-BOOK..... 22
KIRBY & SPENCE'S ENTOMOLOGY..47, 113

LABIUM..... 48
LABRUM..... 48
LADIES' BEE DRESS..... 197
LANGSTROTH, Rev. L. L..... 123
LANGSTROTH FRAME..... 132
figure of..... 124
LANGSTROTH HIVE..... 123
figure of..... 124
LANGSTROTH ON THE HONEY-BEE 21
LARVA..... 68
LATREILLE..... 46

PAGE.
LEAF-CUTTING BEE..... 36
LEGS OF INSECTS..... 56
LINNÆUS..... 45
LIGULA..... 49
figure of..... 91
LOCATION OF APIARY..... 120
LOCUST TREES..... 236
LYONNET..... 46

MALE ORGANS..... 62
figure of..... 63
MANDIBLES..... 50
figure of..... 92
MAPLE.....224, 225
figure of..... 222
MARKET—for honey..... 213
crate for..... 216
figures of.....216, 217
for comb..... 215
for extracted..... 214
how to stimulate..... 213
rules for..... 215
MASON BEES.....36, 37
MAXILLÆ..... 50
MEGACHILE..... 36
MELIPONA..... 35
MICE..... 272
remedy for..... 272
MIGNONETTE..... 231
figure of..... 231
MILK-WEED..... 232
pollen masses of..... 233
figure of..... 233
MIMICRY..... 31
MOUTH PARTS..... 48
figure of..... 49
variation of..... 50
MOVABLE-COMB HIVES..... 123
two types..... 123
MOVING COLONIES..... 187
MULTIPLYING COLONIES..... 171
MUSCLES OF INSECTS..... 56
MUSTARD..... 233
figure of..... 233
NATURAL HISTORY OF THE HONEY-BEE..... 27
NATURAL METHOD OF INCREASE.. 171
NATURAL SWARMS..... 171
means to save..... 173
implements required..... 173
not desirable..... 171
second swarms prevented..... 175
NEIGHBOUR, THE APIARY..... 23
NERVES OF INSECTS..... 57
figure of..... 58
NEUTERS..... 90
cocoon of..... 98
development of..... 96
eggs of..... 96
eyes of..... 92
figure of..... 90
function of..... 99
old workers..... 99
young workers..... 99
honey stomach of..... 92
figure of..... 60
jaws of..... 92
figure of..... 92
larva of..... 97
figure of..... 97
longevity of..... 99
number of..... 90
pollen baskets of..... 93

PAGE.
NEUTERS—continued.
figure of..... 93
pupa of..... 98
figure of..... 97
size of..... 90
sting of..... 95
figure of..... 95
tarsi of..... 93
figure of.....93, 94
tibia of..... 93
tongue of..... 92
figure of..... 91
wings of..... 92
figure of..... 38
NYMPHS..... 69

ORDER..... 30
of insects..... 30
of the honey-bee..... 30
OSMIA..... 37
OVARIES..... 64
figure of..... 64

PACKARD'S ENTOMOLOGY..... 47
PALPI..... 49
PAPERS..... 19
American Bee Journal..... 19
Bee-Keepers' Magazine..... 21
Gleanings in Bee Culture..... 20
PARAGLOSSÆ..... 49
PARASITIC INSECTS..... 32
PARASITIC BEES..... 37
PARTHENOGENESIS..... 80
in bees..... 80
in other insects..... 81
PLANTS..... 220
asters..... 243
figure of..... 243
April..... 223
August..... 242
barberry..... 225
figure of..... 226
basswood..... 237
figure of..... 237
beggar-ticks..... 244
bergamot..... 238
blackberry..... 236
boneset..... 238
figure of..... 241
buckwheat..... 242
figure of..... 242
button-ball..... 238
figure of..... 240
catnip.....232, 240
clover..... 228
Alsike..... 228
figure of..... 229
sweet..... 228
figure of..... 230
white..... 228
figure of..... 228
coffee berry..... 226
corn..... 235
cotton..... 236
figure of..... 236
figwort..... 238
figure of..... 238
fruit trees..... 225
golden-rod..... 242
figure of..... 243
Judas tree..... 225
figure of..... 224

PAGE.
PLANTS—continued.
July 237
June 228
list of 221
locust 236
maples 224, 225
figure of 222
milk-weed 232
pollen-masses 232
figure of 233
mints 232
figure of 232
mignonette 251
figure of 231
mustard 233
figure of 233
okra 232
figure of 231
poplar 225
rape 234
figure of 234
Rocky Mountain bee 238
figure of 239
sage 232
white 226
figure of 227
sour-wood 240
Spanish needles 244
St. John's wort 240
sumac 226
teasel 235
figure of 236
tick-seed 244
tulip tree 234
figure of 235
willow 224
figure of 223
wistaria 225
American 225
figure of 225
Chinese 225
figure of 226
PLINY 44
POISON FROM STING 12
innoculation of 12
POISON SACK 95
POLLEN 111
function of 112
how carried 111
nature of 111
source of 111
where deposited 112
PREPARATION FOR APICULTURE 117
college course 118
plan 118
read 117
visit 117
PRODUCTS OF BEES 104
comb 108
figure of 109
honey 104
pollen or bee-bread 111
propolis or bee-glue 112
wax 106
PRODUCTS OF INSECTS 104
PROPOLIS OR BEE-GLUE 112
function of 113
nature of 112
source of 112
PUBLICATIONS 19
American Bee Journal 19
Bee-Keepers' Magazine 21
Gleanings in Bee Culture 20
PUPA 68
figure of 69

PAGE.
QUEEN 71
brood from eggs 78, 164
cages 184
cell 75
figure of 109, 167
introduction of 167
figure of 167
when started 164
where built 164
figure of 109
clipping wing of 168
how done 169
not injurious 168
why done 169
cocoon of 77
development of 75
eggs of 80, 81
how impregnated 81
Wagner's theory 81
fecundity of 83, 84
figure of 72
food of larvæ 76
function of 83
how procured 185
importance of 163
impregnation of 78
only on the wing 79
introduction of 183
laying of 82
longevity of 83
must have empty cells 188
never to be wanting 163, 176
never to be poor 186
no sovereign 85
ovaries of 72
figure of 64
oviduct of 64
piping of 102
rearing of 78, 163, 186
sex of 71
shipping 186
size of 72
spermatheca of 72
sterility of 83
sting of 71
tongue of 73
figure of 73
wings of 73
QUEEN CELLS 75
figure of 109, 167
how secured 164
introduction of 167
figure of 167
QUEEN REARING 163, 186
QUEEN SHIPPING 186
cage for 186
figure of 187
QUEEN WHITE ANT 84
fecundity of 84
QUILT 136
QUINBY, M 138
QUINBY HIVE 139
figure of 139
QUINBY'S MYSTERIES OF BEE-KEEPING 22
QUINBY SMOKER 198
figure of 199

RABBETS FOR HIVE 125
of tin 125
RACES OF THE HONEY-BEE 41
Egyptian 43
German or black 41
Italian or Ligurian 41

PAGE.
RACES OF THE HONEY-BEE—cont'd.
history of 41
characters of 42
superiority of 181
other 43
RAY 44
REAUMUR 45
RESPIRATION 59
RILEY'S REPORTS 47
ROBBING 258
how checked 258
how prevented 259
when to fear 258
ROCKY MOUNTAIN BEE PLANT 238
figure of 239
ROYAL JELLY 76
RUSSELL HIVE 141

SALICYLIC ACID 261
use of 261
SAGE 232
white 226
figure of 227
SAWDUST 154
SAWS 151
Barnes' 151
foot-power 151
SECOND SWARMS 102
SECRETION 62
SECRETORY ORGANS 61
SECTIONS 147
dove-tail 147
figure of 146
Hetherington 146
glassing 146
Phelps-Wheeler-Betsinger 147
figure of 147
veneer 144
glassing 145
SECTION BLOCK 145
figure of 145
SECTION FRAME 147
figure of 148
where placed 148
SECTION RACK 149
Doolittle 151
figure of 150, 151
Southard & Ranney's 150
use of 149
Wheeler 151
SENSES OF INSECTS 51
hearing 51
seeing 54
smelling 52
feeling 51
SEPARATORS 146, 150
figure of 146
tin 148
figure of 149, 150
wooden 146
figure of 146
SHADE FOR HIVES 153
evergreens 154
grape-vines 153
houses 153
use of 153
prevents idleness 153
prevents melting of comb 153
SMOKERS 198
bellows 198
how used 201
Bingham 199
figure of 199

PAGE.
SMOKERS -continued.
Quinby 198
figure of 199
SOUR-WOOD 240
SPANISH NEEDLES 244
SPECIALISTS 11
SPECIES OF THE HONEY-BEE 41
SPERMATHECA 65
SPIDERS 271
SPIRACLES 59
SPRING DWINDLING 254
STARTING AN APIARY 117
STING 95
figure of 95
STINGLESS BEES 35
STINGS 201
cure of 201
ST. JOHN'S WORT 240
STOMACH 60
sucking 60
true 60
SUB-ORDER 31
Hymenoptera 31
of the honey-bee 31
SUMAC 226
SUN-FLOWER 243
SWAMMERDAM 44
SWARMING 101, 171
after-swarms 102
clustering 102
drone-brood started 101
old colony—how known 102
preparation for 101
drone-brood 101
queen cells 101
prevented 176
when to expect 176
SWARMS 172
hiving 173
easy method 172
second 172
how prevented 172

TACHINA FLY 270
figure of 270
TAILOR-BEE 36
TEASEL 235
figure of 236
THORAX OF INSECTS 48
appendages of 55
TICK-SEED 244
TOADS 272
TONGUE 49
TRACHEA 28, 59
figure of 28
TRANSFERRING 156
method of 156
when easiest 156
TRANSFORMATIONS OF INSECTS 66
incomplete 70
TRIGONA 35
TULIP TREE 234
figure of 235

UNITING 253
when advisable 253

VARIETIES OF THE HONEY-BEE—
see races 41
VEIL 196
figure of 196

PAGE.

VIRGIL 44

WAGNER 19
WAGNER'S THEORY 81
WASPS 271
 remedies for 272
WATER FOR BEES 98
WAX 106
 composition of 107
 function of 108
 how secured 211
 importance of 211
 source of 106
WAX EXTRACTOR 212
 figure of 212
WAX POCKETS 106
 figure of 106
WEISS' FOUNDATION MACHINE 204
 figure of 205
WESTWOOD ON INSECTS 47
WILLOW 224
 figure of 223
WINGS 55
 clipping 168
 figure of 38
 of drone 86
 of queen 73
 of worker 92
 figure of 38
WINTERING 246
 requisites to safe 248

PAGE.

WINTERING—continued.
 absorbents above bees 253
 chaff hives 261
 chamber contracted 253
 colonies prepared 248
 depositories for 252
 cellar 252
 house 252
 house apiary 255
 good food 248
 late breeding 249
 packing-box 250
 figure of 250
 protected if left out 250
 why disastrous 246
 excessive moisture 248
 extremes of temperature 247
 spring dwindling 254
 too early cessation of storing. 247
 unwholesome food 247
WOMEN AS BEE-KEEPERS 15
WORKERS—see Neuters 90
 fertile 77, 90
WISTARIA 225
 American 225
 figure of 225
 Chinese 225
 figure of 226

XYLOCOPA 36

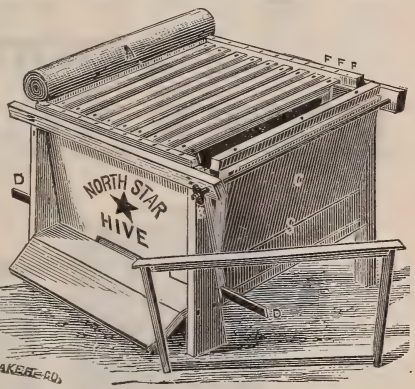
ECONOMY! UTILITY! FACILITY!

Patented June 5, '77.

North Star Hive!

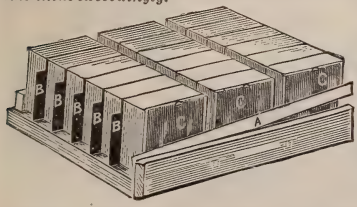
SPERRY & CHANDLER

New London, Minnesota.



THE patentees, after several years experimenting in their own apiaries, now offer the North Star Hive as embracing many improvements on the Langstroth, and all other hives now in use; and while they admit there are other good hives in use for special purposes, yet for all general purposes, such as easy adaptability in working for extracted honey, for comb honey, or for both, it is without a rival. For the *Specialist* it is just the thing, on account of its ease in manipulation; for the *Farmer*, who keeps bees as an auxiliary, it is just the thing, because with the "North Star" he can leave the management of the bees to the care of the good-wife and children; for the *Amateur*, nothing can be better, as all parts of the hive are so easily accessible, that it is but a moment's work to view bee life in all its wondrous phases; and for *everybody* it is specially adapted, as it is so simple and practical in its construction, that it requires neither a scientist nor a machinist to manage it in order soon to acquire a knowledge of bees and successful bee-keeping.

The talented and unprejudiced editors of *The American Bee Journal*, after a fair and impartial trial, say in their May number, 1878, page 141 "Sperry & Chandler have in this something of value. It is also a modification of the Langstroth hive, having *many points of excellence.* Its arrangement for the production of comb honey is, we think, *unexcelled.* Its peculiarities are a manipulating side (C) opening at the top about two inches; rod (B) with thumb-screw to hold the sides together; shape and size of frame 10x16½ inches, tapering two inches; tipping front; easy means of controlling the entrance (D); the quilt to cover the frames attached to the side, and its comb honey rack. *We have some of them in use and like them exceedingly.*"



Our section rack, for comb honey, is receiving universal commendation wherever used. The above standard authority, pp. 156-7, commenting on the merits of several, says: "Another plan, and the best we have seen in that line, is the rack as made by Sperry & Chandler, holding 18 prize boxes, with the separators between them marked B B in the cut. The wedge (A) holds all with a vise-like grasp. The outer boxes are glassed, as they stand on the hive (C C C). By removing the wedge (A) any box may be instantly removed, examined, returned, or replaced by an empty one—the spaces between the rows readily admitting the fingers for that purpose." These racks are adapted to 3, 6, 9, 12, 15 or 18 honey boxes.

When desired, we insert guide-nails in the brood frames; otherwise omit them, as most bee-keepers prefer frames without the gauge.

Prices low and cheerfully given, with any information desired. Correspondence solicited. Address,

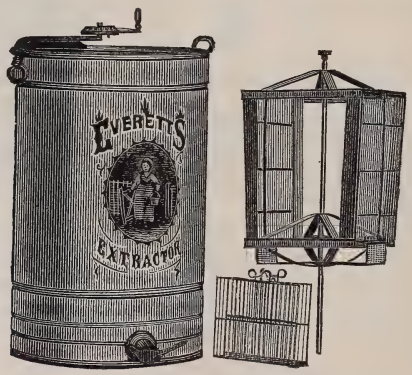
SPERRY & CHANDLER, New London, Minn.,

Or, The American Bee Journal, Chicago, Illinois.

EVERETT'S

HONEY

EXTRACTORS



A

are all well-made, of heavy milk-can tin, and are faithfully portrayed by the above cuts. They all have a wire-basket (A) to hook on to the upper edge of the comb-rack for extracting small pieces of comb.

PRICES:

For two frames 12x20 inches, or less	$8 00
Do. with baskets of wire instead of wire cloth.	8 50
For four Langstroth frames	10 00
For four frames 12x20 inches, or less	12 00
Extra Wire Comb-Basket, for extracting small pieces of comb, each	1 00

I also keep for sale Bingham Smokers, Tin Separators and Bee-Hives. For Price-List apply to

B. O. EVERETT,

107 *Monroe Street, Toledo, Ohio.*

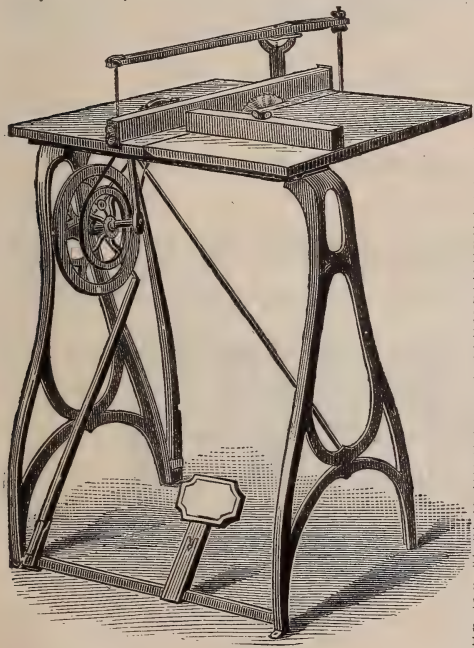
BARNES' PATENT
FOOT-POWER MACHINERY.

Fifteen Different Machines,

with which Builders, Cabinet Makers, Wagon Makers, and Jobbers in Miscellaneous work, can compete as to *Quality and Price* with steam-power machinery.

WILL SEND MACHINES ON TRIAL IF DESIRED.

Every Bee-Keeper should have an outfit from these Machines for hive-making.



We give the following letter from Mr. W. P. Hogarty, of Wyandotte, Kans., to show their usefulness. He says: "If any criticise your circular saw, you can tell them I use it, and with one hand, made all my bee hives for ninety-five stands of bees, including frames and section brace, and I feel perfectly able to do the work for one hundred and fifty stands." * * * "In order that you may know the amount of work on each of my hives, will say, they are two feet long, by two feet high, by about two feet wide. They are double walled and double bottomed, with two inch intervening; and in addition to the nine frames, there are fifteen cases, each case containing two honey boxes and two division boards, and three boxes to contain chaff for winter protection. You will see there is an immense amount of sawing to be done, but I have found your saw equal to the task required of it."

We will send our illustrated catalogue FREE on application. Say where you read this, and address

W. F. & JOHN BARNES,

Rockford, Winnebago Co., Ill.

Imported Queens.



We shall continue to receive

REGULAR IMPORTATIONS,

from the

BEST LOCALITIES IN ITALY,

also from the

Island of Cyprus.

These Queens we will dispose of at the lowest price consistent with the expense incurred, and the care taken in obtaining choice stock.

We will deliver at express office here, in box as received, or forward by mail, as requested.

☞ Safe arrival of all queens will be guaranteed.

C. W. & A. H. K. BLOOD,

BOX 234. *Quincy, Mass.*

We Photograph directly on the Wood!

Thereby Insuring Accurate Representations.



Refer, by permission, to illustrations in this book, as specimens of our work.

BAKER & CO.,

Cor. Clark and Monroe Sts., Chicago, Ill.



THE

AMERICAN BEE JOURNAL

ESTABLISHED IN 1861,

By the eminent bee-master, SAMUEL WAGNER,

is the best scientific and practical JOURNAL OF APICULTURE in the world. The most successful and experienced Bee-keepers in Europe as well as America, write for it.

IT IS **OLDEST,** AND **RELIABLE**



THE **LARGEST,** MOST **BEE-PAPER**

IN THE WORLD.

TERMS: $2 PER ANNUM.

Send 10 Cents for a Sample Copy.

THOMAS G. NEWMAN & SON,

974 *West Madison Street, Chicago, Ill.*

HEADQUARTERS FOR

IMPROVED LANGSTROTH HIVES,

(*WITH MANIPULATING SIDE.*)

All kinds of Honey Extractors, Honey Jars,

ITALIAN BEES AND QUEENS,

COMB FOUNDATION, (Worker or Drone).

SURPLUS HONEY BOXES, OF EVERY STYLE,

FOOT POWER SAWS,

BEE SMOKERS, SEEDS FOR HONEY PLANTS, RACKS AND CASES FOR HIVES, SHIPPING CRATES, HONEY KNIVES,

AND EVERYTHING USFFUL IN AN APIARY.

☞ Send for our Illustrated Catalogue of Implements for the Apiary. SENT FREE.

Address, THOMAS G. NEWMAN & SON,

974 West Madison Street, Chicago.

REV. A. SALISBURY,

DEALER IN

BEES, HONEY and APIARIAN SUPPLIES

IN GENERAL.

ITALIAN QUEENS,

Bred from Imported Mothers of undoubted purity.

The CYPRIAN BEE, in all her beauty and excellence, will be forthcoming in due time.

Full Colonies of Bees, Nuclei Swarms, and Queens, kept on hands.

☞ **Prices low, governed by the rise and fall of the market.**

Camargo, Douglas Co., Ill.

LANE'S SEED ANNUAL.

My Annual Catalogue, a complete Garden and Floral Guide, 90 pages of choice Northern grown seeds, 1,000 varieties; bulbs, garden and apiarian implements, agricultural books, bees, queens, &c., is now ready. Sent postpaid on application. Address,

C. F. LANE,

N. W. Apiary and Seed Warehouse,

KOSHKONONG, WIS.

BROWN & JOHNSTON,

Importers and Breeders of Pure

ITALIAN QUEENS AND BEES.

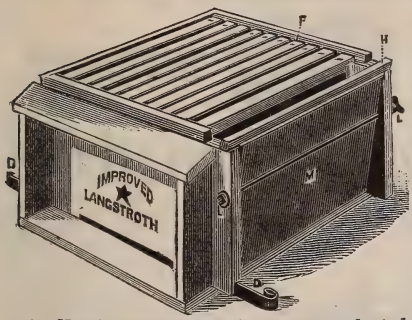
Hives and Material, Comb Foundation, and Implements for the Apiary, for sale.

For Prices address,

H. H. BROWN, Light Street, Col. Co., Pa.,
or CHAS. L. JOHNSTON, Danville, Pa.

NEW LANGSTROTH BEE HIVE,

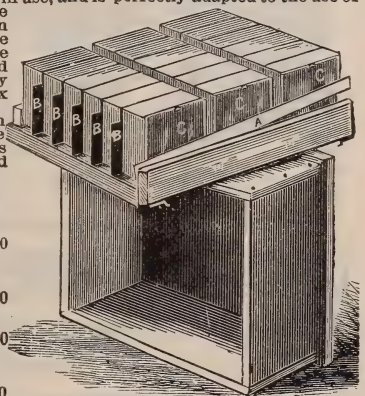
With Manipulating Side.



This Improvement in the old Langstroth Hive is exceedingly valuable, as it allows the closest watching of a colony with the greatest ease and comfort. By turning the thumb-screw, L, and opening the movable side (which takes but an instant) the frames can be examined, and by removing the loose side-board, M, the bottom-board may be cleansed—giving all the advantages claimed for a loose bottom-board, without its disadvantages.

This Hive is a combination of the Langstroth Hive and the North Star Hive—as patented June 5, 1877—and, no doubt, will gain universal approbation as soon as its advantages are known.

The New Langstroth Hive is peculiarly adapted for the production of comb honey—its Honey Rack is the best in use, and is perfectly adapted to the use of the Prize Boxes. It holds 18 prize boxes, with the separators between them, marked B B in the cut. The wedge (A) holds all with a vise-like grasp. The outer boxes are glassed as they stand on the hive (C C C). By removing the wedge (A) any box may be instantly removed, examined, returned, or replaced by an empty one—the spaces between the rows readily admitting the fingers for that purpose. They are adapted to 3, 6, 9, 12, 15 or 18 honey boxes.



Sample Hive—nailed, not painted.

No. 1—One story, brood chamber with 10 frames, portico and 7 inch cap, but no surplus arrangement $2 00

No. 2—Same, with comb honey-rack, prize boxes and tin separators complete, and six boxes glassed..... 3 00

No. 3—Same, but having a 10-inch story with ten extra frames, for extracting 3 50

No. 4—Brood-chamber, 10 frames, and a 7-inch story filled with 7 cases, each containing 3 prize boxes and tin separator 3 50

No. 5—Same as No. 3, but having 7 cases complete instead of Honey-Rack.... $3 50

MATERIAL—Cut, ready to nail—(14⅛x18⅜ inches inside).

In lots of	1-story.	2-story
5 each	$1 25	$1 80
10 "	1 20	1 70

In lots of	1-story.	2-story.
25 each	$1 10	$1 60
50 "	1 05	1 55

In lots of	1-story.	2-story
100 each	$1 00	$1 50

If nailed add 50c. each. If nailed and painted add $1.00 each.

Two-story hives may have twenty frames, comb-honey rack, or seven cases, as may be desired. ☞ Any size hive or frame made to order.

Material for Langstroth Frames, cut, ready to nail, (9⅛x17¾ outside.

100 frames..... $1.50 1000 frames..... $14.00 5000 frames, per 1000,. $12.00

SPERRY & CHANDLER, New London, Minn.

☞For sale at manufacturer's prices, at wholesale and retail, by

THOMAS G. NEWMAN & SON,

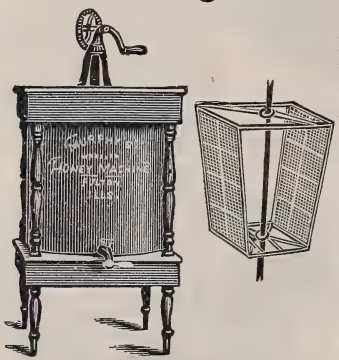
974 *W. Madison street, Chicago, Ill.*

R. R. MURPHY'S IMPROVED HONEY EXTRACTING MACHINE, AHEAD OF ALL COMPETITORS AT THE CENTENNIAL EXPOSITION OF 1876.

Catalogue No. 192—Group 23.

MURPHY'S IMPROVED

Honey Extractor.



Commended for being well made and efficient. The success of the operation, which is to remove the honey without injuring the comb, depends upon the care exercised to take the comb before the cells are capped. The apparatus comprises copper cylinder tinned on the inside, with a vat for the honey at the bottom. Inside the cylinder is a rectangular revolving frame, having its longer sides covered with sieve wire. The comb is placed in the box with the frames in which it was made, and the box is rapidly revolved by a handle and bevel gear. The centrifugal force causes the honey to discharge into the cylinder without the comb being injured, so that the latter is replaced in the hive, and the bees at once commence the process of refilling.

Signature of judges:

John Coleman,	James Bruce.
E. Oldendorff,	Pedro Paes Leme.
Ekedd Kenzo,	James S. Grinnell.

Also manufacturer of

LANGSTROTH HIVES AND FRAMES

HONEY BOXES AND SECTIONS AT REASONABLE RATES,

And dealer in

ITALIAN BEES AND QUEENS

For sale, from Imported Mothers.

Address, R. R. MURPHY,

Garden Plains, Whitesides Co., Ill.

Or Office of The American Bee Journal, Chicago.

PUBLICATIONS FOR THE APIARY,

FOR SALE AT THE OFFICE OF

The American Bee Journal,

974 West Madison Street, Chicago, Ill.

COOK'S NEW MANUAL OF THE APIARY.

This is a new edition of Prof. Cook's Manual of the Apiary, entirely re-written, greatly enlarged and supurbly illustrated.

Being new, it is fully up with the times on every conceivable subject that interests the apiarist. It is not only instructive, but intensely interesting.

It comprises a full delineation of the anatomy and physiology of the Honey-Bee, illustrated with costly wood engravings, full descriptions of honey-producing plants, trees and shrubs, &c., splendidly illustrated—and last, though not least, detailed instructions for the successful accomplishment of all the various manipulations necessary in the apiary.

This work is a masterly production, and one that no bee-keeper, however limited his means, can afford to do without.

It is printed in the best style of the art, on fine book paper, and superbly illustrated throughout. Price, bound in cloth, $1.25, postpaid ; in paper binding, $1.00, postpaid.

THE HIVE AND HONEY-BEE, by L. L. Langstroth.

This is a standard volume, well illustrated and nicely printed. Price, $2.00.

MYSTERIES OF BEE-KEEPING, by M. Quinby.

The author has treated the subject of Bee-Keeping in a manner that cannot fail to interest all who read this work. Price, $1.50.

THE DZIERZON THEORY; peing a full elucidation of Scientific Bee-Keeping.

This "theory" presents in the form of distinct propositions, the fundamental principles of bee-culture, and in this work the late Baron of Berlepsch furnishes a condensed statement of the facts and arguments by which these propositions are demonstrated. It is of untold value to beginners and all others who desire to study the subject of apiculture. It is just what thousands want.

It contains 50 pages and is printed on fine book paper. Price, postpaid, 20 cents, or three copies for 50 cents.

HONEY, AS FOOD AND MEDICINE, by the Editor of the American Bee Journal.

This is a pamphlet of 24 pages, discoursing upon the Ancient History of Bees and Honey ; the nature, quality, sources, and preparation of Honey for the Market ; Honey, as an article of Food, giving recipes for making Honey Cakes, Cookies, Puddings, Foam, Wines, &c. ; and Honey as Medicine, followed by many useful Recipes. It is intended for consumers, and should be scattered by thousands all over the country, and thus assist in creating a demand for honey.—Prices : Single copies, 10 cents postpaid ; 15 copies for $1.00 by mail, postpaid ; 100 copies, with name and address of honey-producer printed on them, $5.00 by mail, postpaid ; 250 copies, by express, at 4 cents each ; 500 or more copies, by express, at 3 cents each. It is published in German also at the same prices.

WINTERING BEES ; How to do it Successfully.

This contains all the Prize Essays on this important subject that were read before the Centennial Bee-Keepers' Association. The prize ($25 in gold) was awarded to Prof. Cook's Essay, which is reported in full in this pamphlet.

It contains 30 pages and is printed on fine book paper. Price, 15 cents, or five copies for 50 cents.

SPECIAL EDITION of the Journal.

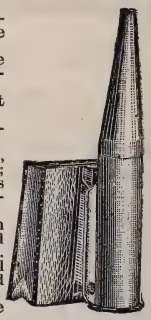
Containing the Official Report of the Proceedings of the National Convention, held in New York, Oct., 16-18, 1877, with all the Essays and Discussions,—together with a description of the implements for the Apiary, on exhibition at the American Institute Fair.—Price 10 cents.

☞ *Send by Postal Money Order, Draft or Registered Letter at our risk.*

THOMAS G. NEWMAN & SON,

974 *West Madison Street, Chicago, Ill.*

Ha! Ha! Ha! Just What I Want!



The Michigan Bee-Keepers' Association, having all the Smokers before it, "pronounced Bingham's Patent Smoker the best."

J P Moore, of Binghamton, New York, after using one some time, said: "My Smoker troubles are all over, and the bee-keepers owe you a debt of gratitude."

Professor Cook, of Michigan Agricultural College, says: "It is the best in the market."

R. M. Argo, Lowell, Kentucky, says: "It is all that any bee-keeper could desire."

Paul L. Viallon, Bayou Goula, Louisiana, writes, April 6th, 1878: "Your Smokers are far superior to any ever invented; and we bee-keepers owe you a vote of thanks for your ingenious invention. Many may try to improve on yours, but I am positive none will make a better one."

This is the first and only bellows Smoker ever made which would burn stove-wood. It burns anything combustible, and needs no care except to be refilled once in one or two hours. Works easy, and will throw a stream of smoke ten feet. It will not go out or wear out. It will save time, stings and money, and perhaps a valuable horse.

The inventor is the only party having a right to manufacture said Smoker, and it is safe to buy of him.

Sent by mail on receipt of price.

Standard Size, Pre-paid.....$1 60
Extra Large, " 2 00
Small, " 1 00

T. F. BINGHAM,

Abronia, Allegan Co., Mich.

FRIENDS! If you are in any way interested in

BEES OR HONEY!

We will with pleasure send you a sample copy of our

MONTHLY GLEANINGS IN BEE CULTURE,

With a Descriptive Price-List of the latest improvements in

HIVES, HONEY EXTRACTORS, ARTIFICIAL COMB,

SECTION HONEY BOXES,

All books and journals, and everything pertaining to bee culture.

NOTHING PATENTED.

Simply send your address on a postal card, *written plainly*, to

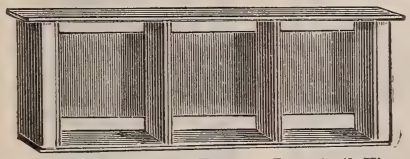
A. I. ROOT, Medina, Ohio.

COMB HONEY.

In order to meet the requirements of the market, those who intend to raise this very popular and delicious article, should use Prize

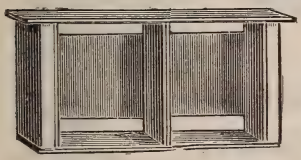


Prize Box.

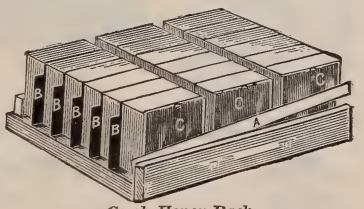


Case to hold three Prize Boxes on Langstroth Hive.

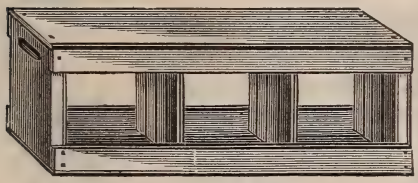
Honey Boxes, getting their honey in them, and thus realize more for it than they can in any other way.



Case for two Prize Boxes for American Hive.



Comb-Honey Rack.



Prize Shipping-Crate.

The Prize Shipping-Crate will hold one dozen single-comb 2-pound Prize Honey Boxes (5x6 inches), and is the Favorite Shipping Crate. Honey in it having been awarded the Thurber Prize Gold Medal, at the National Bee-Keepers' Convention, held at New York, in Oct., 1877.

☞ For Prices of all these articles, as well as EVERYTHING USED IN THE APIARY, send to the office of

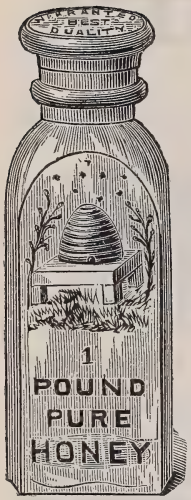
THE AMERICAN BEE JOURNAL,

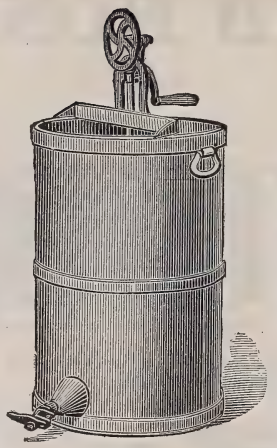
and ask for an Illustrated Catalogue of Implements for the Apiary.

Address,

THOMAS G. NEWMAN & SON,

974 West Madison Street, Chicago.









Bienenstöcke mit beweglichen Gestellen.

Honig-Pumpen.

Italienische Bienen u. Königinnen.

Bienen-Räucherer, Bienenschleier, Gummi-Handschuhe, Künstliche Honigscheiben-Fundamente, Saamen für Honig-Pflanzen,

sowie Alles, was Bienenzüchter gebrauchen.





Zu verkaufen bei:

Thomas G. Newman.

Herausgeber des

"The American Bee Journal."





The American Bee Journal wird monatlich herausgegeben und kostet $2 per Jahr im Voraus. Es ist die älteste Bienen-Zeitung in der Welt, die erfolgreichsten und gebildetsten Bienenzüchter in Europa und Amerika schreiben für ihre Spalten.

Thos. G. Newman & Son, 974 W. Madison st., Chicago.



LIBRARY OF CONGRESS
0 002 837 425 2